THE

FRANKLIN JOURNAL,

AND

AMERICAN MECHANICS' MAGAZINE;

DEVOTED TO THE USEFUL ARTS, INTERNAL IMPROVEMENTS, AND GENERAL SCIENCE.

UNDER THE PATRONAGE

OF THE

FRANKLIN INSTITUTE OF THE STATE OF PENNSYLVANIA.

EDITED BY DR. THOMAS P. JONES,
PROFESSOR OF MECHANICS, IN THE INSTITUTE.

VOL. III.

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PREFACE.

The third volume of the Franklin Journal is now before the public, and if we may judge from the increasing patronage which the work has obtained, this volume has not fallen behind its predecessors. The publication was commenced under circumstances of considerable hazard; the plan of it, was novel in this country; the list of its patrons, small; and the whole responsibility, both literary and pecuniary, rested upon the Editor. With a scattered population, and a vicious mode of subscription, our periodicals have difficulties to encounter, which are unknown elsewhere; these, however, we have surmounted; for, although the Editor has not yet received any compensation for his labour, he has a fair prospect of doing so, as the extension of the subscription list renders a new edition of the first volume necessary, and it is already in the press.

A plan has been devised, and has every probability of success, which will afford the means of greatly increasing the embellishments, and the utility of the work. Its increasing circulation will also justify, and induce, a more liberal expenditure, and a more extensive correspondence; and thus give greater variety, and value, to its pages.

We would again urge upon our artisans and manufacturers, the great advantage which would result from their publishing the results of their observations and experience; and again assure them, that whenever it is necessary, we will gladly remodel their communications; all we ask for, is the statement of useful facts.

We are aware that some may think themselves neglected, who have furnished articles for insertion, which have remained apparently unnoticed; in some instances, these articles have been reserved for future use, but more frequently they have been suppress-

ed, lest the "remarks by the Editor" with which they would have been accompanied, might have destroyed all the pleasure anticipated from appearing in print. We do not object to speculations, but alone, they are generally of little worth; whilst every fact, however simple it may be, is not only valuable for its own sake, but possesses intimate relationship with other facts, and is necessary to be known, in order to give consistency, and connexion, to the train to which it belongs.

Philadelphia, June 1*st*, 1827.

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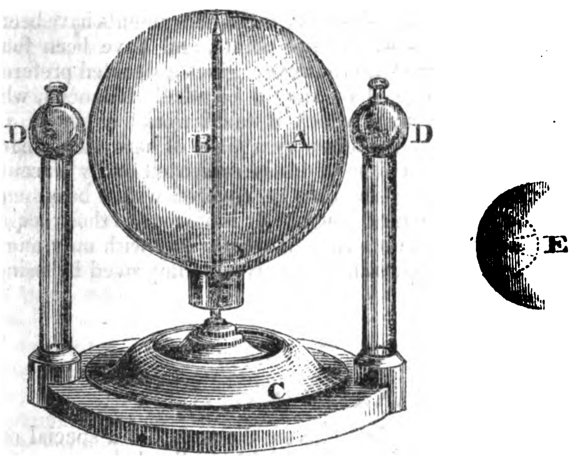
JANUARY, 1827.

Description of an instrument by which electrical attraction and repulsion are illustrated in a new and striking manner. By the inventor, Mr. Franklin Peale.



To the Editor of the Franklin Journal.

Sir—Believing that every thing that can add to the attraction of science, or that can assist in the illustration of its principles, is more or less useful and acceptable to the public, I have taken the liberty

of sending you a humble offering, in aid of the cause in which you are so actively employed.

Several years since, in consequence of an examination of Rakestraw's electrical orrery, and the principles developed by its operation, I formed the instrument, a drawing of which accompanies this communication. I will briefly observe, that the charge of electricity being thrown upon the surface of the glass, the certain, immediate, and *rapid* revolution of the globe, is a simple, and yet effective illustration of the attractive and repulsive power of this agent. It is scarcely necessary to advert to the marked difference that exists between this instrument, and those in which *conductors* are made to revolve by the same agency.

Description.—The glass globe A is supported by the rod B, upon which it can freely revolve; the stand C supports also two pillars of glass, upon which are placed small conductors D D, within which are delicate points, placed as near as possible to the surface of the globe. E is an enlarged view of one of the small conductors, and the points within it.

One of the small conductors being connected with the electrical machine, and the other with the earth, the instrument is ready for operation.

Very respectfully, yours, &c.

FRANKLIN PEALE.

Philadelphia, 21st December, 1826.

Remarks by the Editor.—Some of these instruments have been constructed with plain knobs, without points, and have been found to answer very well; Mr. Peale, however, gives a decided preference to those with points. The globe should be nicely balanced, which is easily done; the point upon which it turns works either in a small conical hole formed in the glass by a piece of hard steel sharpened for the purpose, or in a disc of brass cemented on by warming the glass; the neck of the globe may be covered with a brass cap, perforated for the rod to pass through. It is obvious to those acquainted with electricity, that the instrument would act, with only one of the knobs insulated; its appearance, however, is improved by using glass supports to each.

FRANKLIN INSTITUTE.

We have in our last volume given the report of a special committee on the subject of Professor Renwick's inclined plane; another special committee was appointed to report upon two plans for Dry Docks, which, from the interest which the subject involves, and the high respectability of the projectors, and of the committee; will insure and reward an attentive perusal, by every one who is, or who wishes to become, conversant with the application of scientific skill to mechanical improvements.

Report of a select committee of the Franklin Institute, on a Dry Dock, projected by Commodore James Barron, and also, one by Captain Thomas Caldwell.

The Committee appointed by the Franklin Institute of the State of Pennsylvania, to examine the plan of a Dry Dock, submitted for examination by Commodore James Barron, of the United States Navy, and of another Dry Dock, submitted by Captain Thomas Caldwell,

Report, that the immense importance of dry docks, to the people of this great commercial nation, has induced the committee to delay the presentation of their report, in order that a thorough investigation of the merits, and defects, of the various plans now in operation, and of those now proposed to the Institute, might be effected.

The United States present the only instance existing, of a great commercial people, destitute of dry docks, for building, coppering, examining, cleaning, and repairing their national and commercial marine.

The large ships of war of the nation, are at present suffered to decay when serious repairs are requisite, which might easily be performed, if dry docks were in existence in the Union. The danger and expense from this neglect require immediate attention, and the national welfare demands the establishment of docks, without further delay. The system adopted by our merchants, in heaving down vessels of *large* dimensions, when repairs are required, is at once expensive, dangerous, and incomplete; expensive, for it requires the removal of their cargoes, and of many articles from the ships, to qualify them to withstand this severe and straining operation, whilst much time is lost, and much labour expended, in the processes subsequent to the heaving down, as well as in this preliminary operation; dangerous, as the violent, and unavoidable, straining of the timbers, bolts, copper, &c. must weaken and injure the vessels; incomplete, as thorough repairs cannot in many cases be performed, and as the injury done cannot always be completely ascertained, perhaps not until danger in a storm at sea reveals the extent of the evil, when discovery is almost unavailing, from the impossibility of then repairing the damage; for all these reasons your committee most strongly condemn this process.

Our merchants, aware of these facts, are sometimes compelled to send their vessels to the dry docks of Europe, when coppering, or serious repairs are requisite; the necessity of employing the ship-builders of foreign, and sometimes of hostile nations, (with whom intercourse may be interrupted by national disputes;) and particularly our thus depriving of employment our own ingenious and skilful ship-builders and mechanics, who are now frequently unemployed for a portion of every season, and whose labour is therefore lost to the nation, all dictate the necessity of a change; for it cannot be doubted, that, if dry docks existed in the ports of our country, all the operations of building and repairing vessels, could be performed *here* with *more*

economy, with *greater despatch*, with *equal excellence*, and with *far greater convenience*, than at present.

Many of these advantages will, in a comparative degree, be experienced by such ports, in our country, as may adopt docks, over such as are destitute of these highly important structures.

The committee consider it foreign to the object of their appointment to express any opinion in relation to the railway docks, which have been recently constructed in the United States.

Previously to commencing our examination of the comparative advantages of the plans now submitted to us, we will describe those which have been heretofore in use.

The dry docks employed in Europe resemble, in their structure, the larger class of locks which are used on canals; but they are, usually, far more expensive to construct, in proportion to their relative magnitude. Necessity frequently requires their location in a marshy or loose soil; the dock pit must be excavated to a great depth—frequently much below the surface of the adjoining harbour; much caution and labour are requisite to exclude, or remove, the water from the excavation. To prevent accidents from the adjacent earth slipping in, and thereby injuring, or retarding the works, it is frequently necessary to allow a considerable *slope* to the sides of the dock pits; consequently much labour is expended in the excavation. Many piles, driven to a considerable depth, are required—the masonry demands much labour to ensure durability, and hydraulic cement is indispensable. Stone dry docks are consequently very expensive structures; $75,000 or $80,000 being the least estimate which can be relied on for the cost of a dock,* (including the appurtenances,) calculated for vessels of 3 or 400 tons, and a larger sum for ships of greater magnitude.

A dock of this description could not be completed in less than one, and would, probably, require two years: the interest of the capital employed in constructing the work (which is unproductive during this period) will, of course, add to the above expense, and should no *delay* take place in *commencing* the docks, our shipping must inevitably suffer during the above period of time.

When stone docks are well constructed, few repairs are required; if, on the contrary, the plan, or the structure, be defective, much time, much delay, and great expenditure of money, may be required to maintain them in repair, or to remedy their defects.

When the height of the rise and fall of the tides is greater than the draft of the shipping for which the docks are constructed, steam, or other engines applicable to pumps, are not required to remove the water; but, with the exception of the extreme north-eastern coast of the United States, the maritime districts of our country will require docks in which pumps will be indispensable. The engine employed must be sufficiently powerful to perform this operation with expedition.

* The above estimate is calculated for the vicinity of Philadelphia; land, work-shops, sheds, and other buildings, are not included in it.

In the plan submitted to us by Capt. Thomas Caldwell, which is accompanied by a neatly constructed model, it is proposed to dispense with the use of pumps whenever a supply of water of sufficient elevation can be obtained. He proposes to construct a dock of about *twice* the usual length; to be divided into *two* compartments, by gates situated near the centre of the structure; an additional pair of gates are placed at the *extremity*, opening a communication with the harbour. The vessel enters this *first* compartment—the *external* gates are then closed, and the *internal* opened. The *bottom* of the *second* compartment is *above the level of the water in the first, or outer compartment*, and is consequently at this period *dry*. The water is now permitted to flow from the elevated reservoir, through a pipe, into the docks: when by this means the surface is sufficiently elevated, the vessel is hauled into the *second* compartment, which is constructed in all respects similar to a common dry dock; the central gates are then closed and secured, and the water is *discharged* into the adjacent harbour. This plan may be adopted in any situation, and is entirely independent of the tide, although this may occasionally be of some assistance.

All that is proposed in this plan is to save the *difference* in the expense of erecting steam engines, or other powers applicable to pumps, together with the cost of maintaining them in operation, compared with the cost of pipes, and of obtaining a supply of water. In the cost of these items some saving may perhaps be effected; but all plans of this description, however simple they may appear, must be *far more expensive* than any which are now in use. The money which would be required to construct the *external dock*, or rather lock, of which it is an exact resemblance, would be sufficient to construct one, and perhaps two, dry docks, on the common plan; whilst the interior dock will require the expenditure of the sum usually required, in addition to the former. Steam engines, or other power, could be maintained for a far less sum than the interest of the *extra* capital which we have mentioned above. The committee therefore cannot recommend this plan for adoption.

This method is by no means novel—it has been frequently described, but we believe never adopted.

In all docks, from which it is necessary to remove the water, either by means of pumps, or the action of the tide, some delay always occurs. It is sometimes important that ships should be enabled to proceed to sea with all possible expedition: this remark is applicable to our mercantile, but more especially to our national marine. The success of a naval expedition may depend on the *promptness* with which it can be equipt for sea. A single defective vessel may detain a whole squadron, until the defect can be remedied. The time lost in waiting for a single tide may be of consequence; hence docks, from which the water is removed by powerful engines, may, in some few cases, have advantages over those which depend on the tide for this purpose; the latter, however, are certainly more economical, both in their use and construction. The application of

these remarks will be considered, when we describe the plan of Commodore Barron.

The walls of dry docks necessarily exclude a considerable portion of the light, consequently the workmen are unable to perform their task early in the morning, or late in the evening; artificial illumination has sometimes been partially resorted to, for the purpose of lessening this inconvenience. From the cause above mentioned, some inconvenience is experienced from the want of ventilation; hence the vessels in the dock cannot, when requisite, be expeditiously dried, unless by the aid of fire, the employment of which, for this purpose, has been productive of numerous accidents. An additional evil, resulting from this dampness, and want of ventilation, may be observed in the diseases contracted by the workmen employed in such docks.

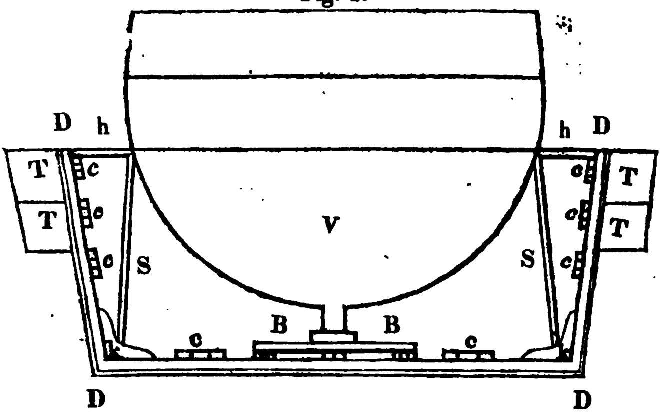
The hulks of old ships are sometimes employed in Europe as substitutes for stone dry docks: they are drawn ashore between high and low water mark, and carefully secured. The stern is cut off, and replaced by a pair of gates; the hold is partly filled with *ballast*, to reduce the buoyancy of the ship; the vessels enter at high tide, and are immediately secured by shores, &c. The water is permitted to escape during the subsiding of the tide; and afterwards kept excluded from the interior of the dock, during the time of repairing the vessel. This plan may be sometimes successfully resorted to for small vessels, in cases of *emergency*; but it is inapplicable to ships of great magnitude. In addition to this objection, an enormous quantity of ballast is required; and notwithstanding all the precautions which may be taken, accidents will sometimes occur from the employment of this insecure apparatus.

In the state of Maine, a plan similar to this has been attempted, but a vessel in the form of a camel, or rectangular trunk, has been substituted for the hulk previously mentioned. The least *inequality on the surface of the soil* on which it rests, will endanger its stability, by causing it to *warp*, and of course jeopardizing the safety of the vessel contained in it. In addition to this, it can only be employed where the tide rises and falls many feet, unless pumps be used.

We now proceed to describe the ingenious plan submitted to us by Commodore James Barron, of the U. S. Navy. It presents the appearance of a large scow, constructed in the strongest manner. The great simplicity of the features of this plan will render it perfectly intelligible by a mere inspection of the subjoined drawing, which represents a section of the dry dock.

D, D, D, D, the dock, k, k, knees at the angles bolted firmly to the horizontal and upright timbers D, D, D, D.—c, c, c, c, c, horizontal or inclined slips of ceiling running fore and aft, into which the timbers D, D, D, D, are inserted. The external planking of the dock is to be well caulked. T, T, T, T, are air tight trunks, to preserve the buoyancy of the dock when filled with water. V, the vessel in the dry dock. S, S, two of the wale shores supporting the ship h, h, horizontal shores. B, B, blocks under the keel.

Fig. 1.



Port holes, which may be rendered water tight, similar to those in ships of war, are placed at suitable intervals in the sides of the dock; these will permit the access of light and air, a great advantage which is not possessed by the *docks* now in use: these port holes also offer facilities for the introduction of timber, &c.

At the extremity of the dock, facing the harbour, the gate is placed—this may be of the usual form, or in detached parts, or the *floating gate* may be employed. The latter has been for a long time in successful operation in Europe.

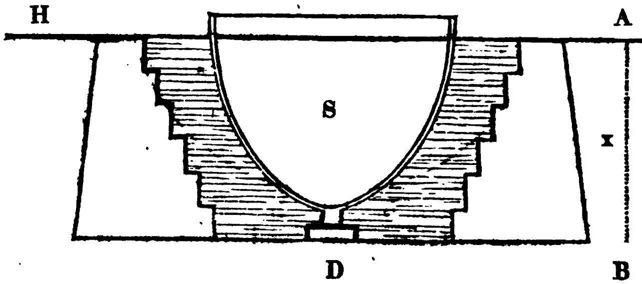
If this dock be employed in salt water, where the worms are destructive to timber, it will be necessary to protect it with copper, &c. This will be requisite only on the bottom and sides; the latter will require coppering only as high as the *floating line* of the dock containing the vessel, when the former contains *no water*. The same remark is applicable to the copper bolts. As the dock is exposed to little friction, the thinnest sheets of copper may be employed.*

We now proceed to describe the method of using this structure. When the gates are open the dock is full of water, and sinks to a depth sufficient to allow vessels to enter therein, and of course to displace their weight of water from the dock—when the gates are closed and secured. The vessel is then shored, &c. in the usual manner employed in dry docks. The water must be removed either by common pumps, by Archimedes' screws, or by a pump which forces out the water through an aperture in the bottom. This latter method is decidedly the best, for by means of it the water can be removed in one-fourth of the time which would be required by the first plan.

* If the experiments of Sir Humphrey Davy be conclusive, the copper may be perfectly protected from corrosion in salt water, by employing iron guards. The adhesion of barnacles, &c. which may be the result of preventing the oxidation of the copper, will be no impediment whatever to the operations of the floating dry dock.

For the purpose of explaining this subject, we will describe the process of pumping out the water from a common dry dock, and the power which is requisite for this purpose, compared with the floating dock of Commodore Barron.

Fig. 2.



In figure 2, D represents *a dry dock of the usual form*, S the ship, H, A the level of the water in the harbour and dock, the line A, B, the depth of the dock, for instance 20 feet.

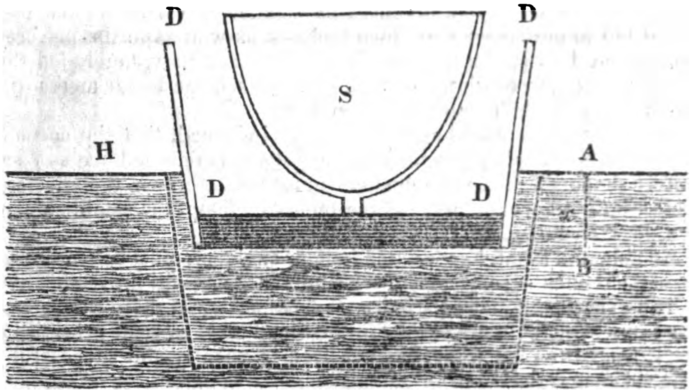
At the *commencement* of the operation of pumping, as the *level* of the water in the dock and harbour is the *same*, no power is requisite to remove the water from the dock, (if the friction of the pumps be not considered,) as the pumping proceeds, the *surface* of the water in the *dock* sinks *below the level*, H, A of the water in the harbour; of course, power is now required *to elevate* the water. The difference between the height of these two surfaces continually increases, until the last portion of water in the bottom of the dock is to be removed, when the elevation to which the water must be raised is the greatest, viz. from B to A, (20 feet) of course the greatest power is required at this period of the operation. Therefore if every foot in depth of the dry dock contain equal quantities of water,* the *average* power required during the *whole* of the operation must be sufficient to elevate a quantity of water equal to the cubic contents of the dry dock, to a height equal to *one-half* of the depth A, B of the dock, D. viz. to the half of 20 feet = 10 feet = x. A. This supposes that the level H. A. of the water in the harbour remains constant. In the floating dock of Commodore Barron, much less power is required to remove the water.

Let D, D, D, D, figure 3, represent the floating dock, containing the ship S. H, A, the surface of the water in the harbour, which would coincide with the surface in the dock, supposing it to be sunk to the dotted line, which is its situation when full of water: this depth we suppose to be 20 feet, or equal to A, B, figure 2. At the commencement of the operation of pumping the water from the floating dock, it resembles the common dock in not requiring any power to ex-

* In practice the *lower* portion of the dock will, from the form of the enclosed ship, contain more water than the upper portion, and of course require more power, and more pumping to remove it.

haust it; but as the pumping proceeds, the dock becomes lighter, and of course the bottom does not remain in the same relative position to the surface of the water in the harbour, but rises in proportion to its buoyancy.

Fig. 3.



The above figure (3) represents this dock as having risen in consequence of the removal of the water, H, A, being the surface of that in the harbour; it is now immersed to the depth of A B, only, which, in a dock of the magnitude hereafter to be mentioned, will be about 5 feet,* consequently, as the water is forced out through an aperture in the bottom, the *greatest* resistance to be overcome is equal only to the pressure of a column of water, equal in height to the line A, B, (5 feet) half of this, or A, x, = 2½ feet, will be the *average* resistance during the whole operation. Therefore the power required to remove the water from the floating dock by a forcing pump, will be to the power required to remove the water from a common dry dock on the usual plan, as 2½ is to 10, or as 1 to 4, viz. as A, x, figure 3, = to 2½ feet, is to A, x, figure 2 = 10 feet. If, however, lifting or forcing pumps be employed to pump the water up, and discharge it *over the sides*, the *same* power would be required both for the fixed and for the floating dock: of course the forcing pump previously mentioned, will be adopted for the floating dock.

The dock of Commodore Barron is to be moored in a slip between two wharves or breakwaters, which will flank and protect it from injury; a raft, or floating breakwater, moored in the harbour in front of the dock gate, will preserve it from damage by storms, &c.

The repairs of this structure can be effected with despatch and economy—if the bottom requires inspection, the dock can be hauled up on a common building slip, and examined.

* As it will not be necessary to remove the water from the space occupied by the ballast, (represented by the shaded compartment in the lower part of the figure,) the additional depth to which the dock will sink, will not affect the result of the calculation we have given.

No danger can be apprehended from the bottom, or other parts of the dock warping, for this can be prevented by proper care in the construction.

Your committee have now fully, and decidedly, stated their opinion of the ingenuity, the economy, the safety, and the perfect practicability, of the valuable plan invented by Commodore Barron; but they would fail in gratifying their own feelings, as well as in the performance of the duty which they owe to the public, if they concluded this report without earnestly recommending this scheme to our mercantile community, for their immediate adoption.

The most prudent and cautious may be informed, that the correctness of the principles on which this dry dock is founded are so completely demonstrable, that success cannot fail to crown the efforts of those whose enterprise may induce them to attempt the establishment of a dock on this plan.

An able and faithful superintendant, or engineer, must be employed, as, without such supervision, every similar scheme will prove abortive.

The experiment may be tried, on a small scale, by those whose caution induces them to dread the failure which may, by some possibility, result from any plan which has not been frequently and successfully reduced to practice.

In the event of a trial, only $4,400 need be *expended* on a floating dry dock, calculated for the reception of vessels of 300 tons. Wharves and floating rafts, which will form a sufficient temporary protection, can be easily procured—common pumps, worked by men or horses, will be sufficient to remove the water.*

If the experiment be successful, the most ample remuneration must inevitably be the reward of the proprietors—if the plan proposed be unsuccessful, the materials of which the dock will be constructed can be sold for $1,400, and a loss of $3,000 only can possibly occur. The dock can be finished in the short space of two months.

If the experiment on this scale be successful, (and of this the committee do not entertain the smallest doubt,) the most timid will not hesitate to try the plan on a larger scale, and with the additions thereto which convenience may require. All which is respectfully submitted by

J. Humphreys, *U. S. N. Consr.*
Chs. Stewart, *U. S. Navy.*
A. J. Dallas, *U. S. Navy.*
Hartman Bache, *Topog. Eng.*
John Randel, jun. *Civil Eng.*
Geo. W. Smith,
†John Wilson, *Civil Eng. of S. Carolina.*

* The total expense of these items for a permanent establishment will not exceed $6000; or the *total* expense for such an establishment will be only $10,400.

† It may be proper to state, that Mr. Wilson was present at the several meetings of the committee, and approved of the notes then taken by the Secretary. As these required some alteration in their arrangement to render them fit for publication, and as Mr. Wilson was compelled to leave Philadelphia in the interval, it was impossible for him to attach his signature in time; and it has therefore been done during his absence. This explanation is due to him and to the public.

FOR THE FRANKLIN JOURNAL.

MECHANICAL JURISPRUDENCE.—No. XII.

BY PETER A. BROWNE, ESQ.

On the law of Patents for new and useful Inventions.

Having, in the last essay, concluded our remarks on that rule which requires that the invention or discovery should be *new*, we come now to the next qualification of an invention, in order to give validity to the patent, which is that it shall be *useful.*

The proviso in the statute of James, is, "so as also they be not contrary to the law, nor mischievous to the state, by raising the price of commodities, nor generally inconvenient."

The 1st section of the act of congress says, "that when any person or persons, being a citizen, &c. shall allege, that he or they have invented any new and *useful* art, machine, &c. &c."

Lord Coke, 3 Institutes, 184, says: "Fourthly. The privilege must not be contrary to law. Fifthly. Not mischievous to the state, by raising the price of commodities at home. Sixthly. Not to the hurt of trade. This is very material and evident. Seventhly. Not generally inconvenient."

Most of the above qualifications enumerated in the proviso of the statute, and relied on by our annotator, are, it is believed, included in the comprehensive word, "*useful*," which is found in the act of congress. That which is illegal, mischievous, hurtful to trade, or generally inconvenient, cannot be USEFUL.

It is stated in Hawkins' Pleas of the Crown, B. 1. ch. 79. s. 24, that "it hath been holden, that a new invention to do as much work in a day by an engine, as formerly used to employ many hands, is not within the said exception, because it is *inconvenient* in turning so many labouring men to idleness."

For the authority of the rule, there are cited 3 Institutes, 184 and 10 Modern rep. 181. In the former we find the following. "There was a new invention found out heretofore, that bonnets and caps might be thickened in a fulling mill, by which means more might be thickened and fulled in one day, than by the labours of fourscore men who got their living by it. It was *ordained* that bonnets and caps should be thickened, and fulled, by the strength of men, and not in a fulling mill, for it was holden inconvenient to turn so many labouring men to idleness."

The word "*ordained*" is used by Lord Coke, which refers to a *statute*, and not to any principle of the common law, or adjudged case. And in truth his lordship refers in the margin, to several ancient (and it is believed obsolete) statutes, one of which made in the 22d year of the reign of Edward the 4th, (1483) ch. 5 enacts, that no person shall full, or thick, any hats, bonnets, or caps, at any fulling mills, or set to sale any so fulled, upon pain to forfeit 40*s*.

In the latter book, namely, 10th Modern rep. 181; there is no such decision as is quoted; nor is there in any English book of reports that

we have examined, a case, or dictum, to justify the general assertion made in Hawkins. We therefore feel ourselves warranted in saying, that it is not, nor ever was, the common law of England. Nor are they prohibited by the statute.

The case of the king v. Arkwright, 1785, referred to in Bul. N. P. 77, four issues were joined on the record of a scire facias, to repeal a patent: the first was, that the patent was *inconvenient* to his majesty's subjects, in general. Under this issue, it was most probably intended to overturn the patent, upon the ground that, being a labour-saving machine, it was not within the statute. It was a machine for preparing silk, cotton, flax, and wool, for spinning. But Buller J. held, that the first issue was merely a consequential one; it stated no fact which could be tried by a jury, or which the defendant could come to answer, and therefore he refused to hear any evidence but what applied to the other issues. In the famous cases of Boulton and Watt, v. Bull and Hornblower, (1795) and of Maberly v. Boulton and Watt, (1799) which, in their discussions, commanded the talents of the first characters of the British bar, this objection was not relied on by the counsel, nor directly mentioned by the court.

C. J. Eyre expresses himself thus: "In the list of patents with which I have been furnished, there are several for new methods of manufacturing articles in common use, where the sole merit, and the whole effect produced, are the *saving of time and expense*, and thereby lowering the price of the article, and introducing it into more general use." A sentiment utterly irreconcileable with the idea that patents taken for labour-saving machines, are invalid. I therefore feel myself warranted in asserting that labour-saving machines *are* within the proviso of the statute of James, and are proper subjects for a patent. In the United States, the propriety of their being secured by patent, has never been judicially called in question.

In an action brought for infringing a patent right, the plaintiff must prove that it is *useful*. This was decided by Sir Vicary Gibbs, in Bovill *v.* Moore, in 1816. "In point of law (says he) it is necessary that the plaintiff should prove that this is a new and useful invention, in order to entitle himself to the present action."

By the term "useful," mentioned in the statute, is meant not an invention in all cases superior to the modes now in use, for the same purpose, but *useful* in contradistinction to frivolous, and mischievous inventions.

In Lowell v. Lewis, 1 Mason's reports, 182, which was a contention respecting the patent of Jacob Perkins, for a useful invention in constructing pumps, one ground of defence was, that it was not useful. Judge Story charged the jury, that "the plaintiff must establish the invention to be useful; for the law will not allow the plaintiff to recover, if the invention be of a mischievous or injurious tendency. The defendant, however, has asserted a much more broad and sweeping doctrine; and one, which I feel myself called upon to negative in the most explicit manner. He contends, that it is necessary for the plaintiff to prove that his invention is of general utility; so that in fact, for the ordinary purposes of life, it must supersede the pumps in com-

mon use; in short, that it must be, for the public, a better pump than the common pump; and that unless the plaintiff can establish this position, the law will not give him the benefit of a patent, even though, in some peculiar cases, his invention might be applied with advantage. I do not so understand the law. The patent act uses the phrase '*useful invention*' merely incidentally; it occurs only in the first section, and there it seems merely descriptive of the subject matter of the application, or of the conviction of the applicant. The language is, 'when a person, or persons, shall allege, that he, or they, have invented any new and useful art, machine,' &c. he or they may, on pursuing the directions of the act, obtain a patent. Neither the oath required by the second section, nor the special matter of defence allowed to be given in evidence by the sixth section of the act, contains any such qualification, or reference to *general utility*, to establish the validity of the patent. Nor is it alluded to in the 10th section as a cause for which the patent may be vacated. To be sure, all the matters of defence, or of objection to the patent, are not enumerated in these sections; but if such a one as that now contended for, had been intended, it is scarcely possible to account for its omission. In my judgment the argument is utterly without foundation. All that the law requires, is, that the invention should not be frivolous, or injurious to the well being, good policy, or sound morals of society. The word '*useful*,' therefore, is incorporated into the act, in contradistinction to *mischievous* or *immoral*. For instance, a new invention to poison people, or to promote debauchery, or to facilitate private assassination, is not a patentable invention. But if the invention steers wide of these objections, whether it be *more or less useful*, is a circumstance very material to the interest of the patentee, but of no importance to the public. If it be not extensively useful, it will silently sink into contempt and disregard."

The next qualification of the invention is, that, in ENGLAND, it must be a *manufacture;* in the United States it must be an *art, machine, manufacture, or composition of matter.*

The prohibitory part of the statute of James, is much more extensive in its terms, than the proviso, as a comparison will show. The prohibitory part says, that all monopolies, &c. &c. for the sole buying, selling, making, working, or using, &c. The proviso includes only working and making; leaving out the buying, selling, and using.

Again. The enacting clause inhibits the sole buying, selling, making, working, or using *any thing;* the proviso saves *any manner of new manufactures.* The only thing then, which under this statute can be legally patented, is the *working*, or *making new manufactures.*

Here an important question arises; what is the meaning of the word "manufactures?"

Manufactures, in its ordinary sense, means "composition of things." But the sense in which it has been adjudged to have been used by parliament, is much more extensive.

Lord Kenyon in Hornblower v. Boulton, 8 Term rep. 99, (1799) defines *manufacture* to be "something made by the *hands* of man." This is giving it a very general signification; but I believe it will be

found to be still more extensive than this definition admits. Watt's patent was for a *method* of lessening "the consumption of steam, and fuel, in fire engines;" and on the most solemn argument it was held valid. There is an embarrassing obscurity in the reasoning of the judges in the above case, which arises from their employing the technical terms, "*principle*," "*method*," "*engine*," &c. &c. in different senses; but the gist of the decision is plainly this, that the *method*, or *means*, by which a new and useful thing can be effected, is patentable, provided the author describes particularly the process by which it can be practically accomplished. Now this method, or means, cannot be said to be the work of men's *hands*.

The decisions upon the statute of James, warrant me in saying, that the word "manufactures," includes two distinct things.

1. The *method* or *manner* of working or making a thing. 2. The *thing* worked or made.

1. The *method* or *manner* of working or making a thing. The first rule with respect to this is, that it must not be a *mere abstract or philosophical principle*.

This is admitted by Lord Kenyon in the case last quoted, page 98. He says, "the principal objection made to this patent is, that it is for a *philosophical principle* only, neither organized, or capable of being organized; and if the objection were well founded in fact, it would be decisive."

So Gross J, in page 101, says, "as to the first of these propositions, that under the statute of James there cannot be a patent for a *mere principle*, it is not necessary for me to form a decided opinion in that point." And afterwards, in the same page, he adds, "I am not prepared to say that a patent for a *mere principle*, was intended to be comprehended within these words." Lawrence, Justice, page 105, says, "if it were necessary to consider whether or not *mere* abstract principles are the subject of a patent, I should feel great difficulty in deciding that they are."

In Barrett v. Hull, 1 Mason's reports, 470. Judge Story says, "in the minds of some men, *a principle* means an elementary truth, or power; so that, in the view of such men, all machines, which perform their appropriate functions by motion, in whatever way produced, are alike in principle, since motion is the element employed. No one, however, in the least acquainted with law, would for a moment contend, that a *principle*, in this sense, is the subject of a patent."

But if the patentee describes the particular method, or manner, in which the principle can be applied, so as to produce a new, and useful effect, that is a "*manufacture*," and is patentable.

Watt's invention before noticed, is an instance. It is a practical application to all fire engines, of the philosophical principles, of the expansiveness, and condensibility of steam. So also Hartley's invention for securing buildings from fire, by the method of disposing of iron plates, as justly observed by C. P. J. Eyre in 2d H. Blackstone's rep. 493, was not a patent for the iron plates, but for a mere negative quality of absence of heat, *by means of the disposition of them*.

Lord Kenyon says, that no technical words are necessary to ex-

plain the subject of a patent. It seems from the list of patents produced in the case in 2 Hen. Blackstone's Reports, and from what is said by Rooke J. that the word in general use in England to express this kind of invention is "*method*;" but I cannot agree with Lawrence J. that *method* means "*engine*."

Judge Story, in the case of Barrett v. Hull, 1 Mason's Reports, 470, to what was above quoted, adds, "The true legal meaning of the *principle* of a machine, with reference to the patent acts, is *the peculiar structure, or constituent parts of such machine*."

The second acceptation of the word "manufacture," will be considered in the next essay.

ON ENGRAVING.

(From the Mechanics' Gallery. By C. F. Partington.)

(Continued from page 312, vol. 2.)

On Engraving upon wood, and on glass.

The history of *wood engraving*, to which we would now direct the reader's attention, is exceedingly interesting.

With regard to the origin of the art, Papillon tells us of eight engravings on wood, the account of which was given to him by a Swiss officer. These must have been considerably more ancient than any thing now known, and upon which a decided opinion may be given with respect to the date. The title, according to that author, ran thus: *Les Chevaleureux Faits en figures du grand & Magnanime Macedonian Roi, le preux & Vaillant Alexandre, dedie, &c.* "A representation of the Warlike Actions of the great and magnanimous Macedonian King, the bold and valiant Alexander, dedicated, presented, and humbly offered to the Most Holy Father, Pope Honorius IV. the glory and support of the church; and to our illustrious and generous Father and Mother; by us, Alexander-Alberic Cunio, Chevalier, and Isabella Cunio, twin brother and sister: first reduced, imagined, and attempted to be executed in relief, with a small knife, on blocks of wood, made even and polished by this learned and dear sister, continued and finished together at Ravenna, from eight pictures of our invention, painted six times larger than here represented; engraved, explained by verses, and marked upon the paper, to perpetuate the number, and to enable us to give them to our relations and friends, in remembrance of friendship and affection. These were completely finished by us both, at the age of sixteen only."

If this story be true, and such engravings with the foregoing title ever did exist, they must have been executed in the years 1284, or 1285; for Honorius IV. to whom the work is dedicated, sat only those two years in the Papal chair. But as Papillon gives this story upon the sole evidence of the Swiss officer, and had never seen any part of the engravings, the generality of authors have not been inclined to give much credit to the tale, which at best is exceedingly doubtful.

The most probable conjecture concerning the origin of this species of engraving is, that it was introduced into Germany by the **BRIEF-MALERS**, or painters of the playing-cards, who cut the outlines of figures on wood, and stamped them upon the paper, to save the trouble of making a separate drawing for every card; and afterwards coloured them by hand. Precisely in this manner were executed the blocks for the cuts in the edition of the Apocalypse, which is now preserved in the Bodleian library at Oxford.

Baron Heineken asserts, that cards for playing were invented in Germany, where they were in use as early as the year 1376, though the reason he gives is not by any means conclusive: *parcequ'on les connoissoit vers ce temps en France*, "because they were known about this time in France." Other authors, with Bullet at their head, as confidently assert, that they were invented in France. The disputes upon this subject serve only to prove the difficulty, if not the impossibility of ascertaining the era of the invention of cards, or the country in which they were first produced. This, however, is of no consequence to the present inquiry, unless it could also be proved that a part of them was printed on blocks of wood, at the time of their first invention. There seems to be very little doubt but that they were drawn, and painted, by hand.

The wood most proper for engraving upon, is box-wood, which should be cut to the height of printing types, by slices from the trunk of the tree, cut at right angles to the pith. This is done in order that the engraving may be executed on the end of the wood, as the graver will not, in all directions, make a smooth stroke upon any other side of the wood, nor would the work be so durable, if the fibres did not stand perpendicularly, while the block would be more liable to warp.

The piece of wood being planed very smooth, the design is drawn upon it with a black-lead pencil; then every black line which the engraving is to exhibit, is to be left untouched, but all the intermediate spaces are to be cut out, with the square or lozenge gravers, used on copper, or with tools of various sizes, with handles like gravers, and the same length, but shaped like chisels. In this process it is obvious that manual dexterity is the main requisite.

The art of *engraving upon glass* appears to have been suggested by the experiments of the French chemists towards the close of the last century. M. de Puymaurins, who is generally considered to be the first who treated upon this subject, thus describes his earliest experiments.

"Imitating the process of engravers upon copper with aqua fortis, I covered a piece of glass with a coat of wax, and, having drawn some figures upon it, I applied fluor-acid over the whole, and exposed it to the sun. I observed soon afterwards that the lines which I had drawn were covered with a white powder, arising from the dissolution of the glass. After four or five hours I took off the coat of wax, and cleaned the glass. I then found, with the greatest satisfaction, that my conjectures were true, and I was thereby assured that a skilful engraver might, by means of the fluor-acid, engrave upon the hardest glass, in the same manner as he can engrave upon copper with aqua fortis.

"But though the result of my first trial was such as to encourage me to proceed, I could not help remarking that the lines of the engraved figure were of unequal thickness, and full of irregularities. As I was ignorant even of the first principles of engraving, I could not hope to be able to bring this discovery to perfection; but I thought it right that I should endeavour to remove those causes to which the inferiority of my work was owing.

"The coat of wax had been laid on too thick, which had prevented me from giving to the outlines of my drawing, the delicacy they ought to have had; and the action of the fluor-acid had rendered them thicker in those parts where the coating was not evenly laid on.

"I soon found that it would be necessary to make use of a varnish, which should be sufficiently thin to admit of shading, and performing other delicate parts of engraving; and at the same time so strong, that, when applied evenly upon the glass, it should not be taken off, or destroyed, by the action of the acid."

The difficulty of applying a substance of that kind upon the surface of glass, makes this part of the operation very troublesome. The strong varnish used by engravers, was found to answer pretty well, but the smallest negligence in applying it, renders it apt to scale, and to be penetrated by the acid. The glass then becomes dull, the lines are rough, and consequently the engraving is imperfect. To bring engraving upon glass to its highest perfection, therefore, it will be necessary to discover a new kind of varnish, which shall have the properties requisite for the purpose. M. de P. tried, with tolerable success, the strong varnish of the engravers, described in the French *Encyclopédie*, and which is composed of equal quantities of drying oil and mastich. But it is very difficult to apply it evenly; and it is very long in drying, especially in winter, as it requires to be exposed to a pretty strong heat, in order to deprive it of its pitchy quality.

Before the varnish is applied, the glass must be thoroughly cleaned, and heated, until the hand can be hardly borne upon it. The varnish is then to be applied lightly over the glass, and laid smooth by dabbing it with small balls of silk stuffed with cotton. It is then to be exposed to the smoke of small wax-candles, as is done by the engravers with respect to copper-plates, when they make use of aqua fortis.

When the varnish is very dry, and the surface very even, the figure intended to be engraved, is to be traced in it. But the dark colour of the glass not showing the lines, as copper does, the engraver cannot see what he does, unless he holds the glass up to the light. As this situation would necessarily render his work difficult and troublesome, M. de P. contrived a table, the upper part of which might be raised in form of a desk, and consequently make the task of the engraver more easy. In the middle of this table, a pane of glass is fitted; upon it the engraver places the varnished glass on which the engraving is to be made. The glass having light thus thrown under it, the lines made by the engraver's tool become visible, and consequently, he can not only work with great ease, but can judge of the effects his work will produce.

Artists alone can give to this invention the extent and perfection

which it is capable of receiving. But it may not be amiss to inform them of the precautions which are necessary, to prevent their losing, in an instant, the fruits of a tedious and tiresome operation.

It is necessary, First, to be well acquainted with the quality of the glass made use of. Secondly, to ascertain the strength and purity of the fluor-acid. Thirdly, to attend to the temperature of the atmosphere.

Bohemian glass is not of an equal quality in all its parts; the substances of which it is composed have not undergone a sufficient fusion to be well mixed. The fluor-acid acts upon it unequally; the lines engraved upon it are rough, and have not a good appearance, except when viewed on that side of the glass which is opposite to the engraving. English glass, in the composition of which a great quantity of calx of lead enters, is easily acted upon by the acid, but the least defect in the varnish lets the acid penetrate; the calx of lead is first acted upon, and its solution gives a disagreeable tinge to the glass. Plate-glass is the substance which the acid acts best upon; the siliceous earth is there so prepared by the heat it has suffered, that the acid meets with it in the state most proper for its action.

That plate-glass which has a white reflection, not a green one, must be chosen. The glass used for small looking-glasses seems to merit the preference. The lines of the engravings made upon it, are equal in depth, and have no irregularities.

It is necessary to know the degree of purity of the acid employed. That which is distilled in a glass retort (being mixed with sulphuric acid, and saturated with the siliceous earth of the retort) is less strong, and less equal in its action.

In the summer season, when the weather is clear and serene, a piece of plate-glass, varnished, traced, and covered with the acid, is exposed to the sun, the engraving is completed in five or six hours; this is known by a white powder, which covers the lines drawn upon the glass. In winter, the glass is but slightly attacked in four days, and the operation would never be finished, if the action of the acid were not assisted by a moderate and regulated heat, such as that of an oven, or a stove. The glass must not be heated by applying heat under it, because the varnish thereby becomes soft, and scales off; the acid consequently penetrates to all parts, and the glass is made rough, without any regular figure being produced.

We may engrave on glass either in relief or otherwise. If it is proposed to engrave in relief, the varnish which covers the ground on which the figures are traced, must be taken off with a scraper; the fluor-acid must then be applied, and spread evenly with a small brush. If the action of the acid is assisted by the heat of the sun, the glass soon becomes covered with a white pellicle; which is to be taken off, and fresh acid applied, until the ground is thought to be so much deepened, that the figures have a sufficient relief. When it is proposed to take the polish from certain parts of glass, the same operation may be practised.

To engrave in the common way, the glass must have a border of

engraver's wax put round it, and, in all other respects, we must proceed as is usual in engraving with aqua fortis.

In order to judge of the state of the engraving, a corner of the glass must be exposed, and examined. If the operation appear to be finished, the acid is to be poured off, and the same acid may sometimes be employed more than once. The glass is to be drained, then washed two or three times with clean water to take away the superabundant acid, and afterwards dried. The varnish may be taken off with a coarse cloth, dipped in spirit of wine, and the glass may be cleaned with chalk finely powdered.

On Clock and Watch-making, and on purifying oil for pivots.

We have now lying before us a very excellent treatise on Watch and Clock making, by Mr. Thomas Reid, of Edinburgh.

This gentleman having retired from the active pursuit of his profession, to which his whole life has been devoted, has now, at the advanced age of fourscore, completed a work, which we have little hesitation in saying, is the best treatise on the subject, extant. In it, he has endeavoured to combine his own observations with those of the best practical writers, and to give to the operative watch and clockmaker, a condensed view of the art in Great Britain, and on the continent of Europe. The work consists of thirty-three chapters, with an appendix, and is embellished with twenty plates of engravings. On the subject of oil for watches and clocks he gives the following information.—*Ed. Lon. Mech. Mag.*

A receipt to deprive oil of its acid.

To four ounces of the best spermaceti oil, add four grains of *kali æratum* in five ounces of distilled water, shake them well for a day or two, then pour the whole into a tumbler, covered by another, and when exposed to the light for three or four weeks, the pure oil will float on the top, to be skimmed off by a tea-spoon. This oil, it is said, neither dries nor turns green.

Oil may be prepared in the following manner:

Put a quantity of the best olive oil in a phial, with two or three times as much water, so as the phial may be about half full. Shake the phial briskly for a little time, turn the cork downwards, and let most of the water flow out between the side of the cork and the neck of the phial. Thus the oil must be washed five or six times. After the last quantity of water has been drawn off, what remains is a mixture of water, oil, and mucilage. To separate these from each other, put the phial into hot water for three or four minutes, and most part of the water will fall to the bottom, which must be drawn off as before. The oil must then be poured into a smaller phial, which being nearly full, must be well corked, set in a cool place, and suffered to stand for three or four months, or until the water shall have subsided, with the mucilage above it, and the oil perfectly transparent, swim-

ming on the top of the mucilage. When time has thus completed the operation, the pure oil must be poured off into smaller phials, and kept in a cool place, well corked, to preserve it from the air. This, by Mr. E. Walker, of Lynn, dated 13th Nov. 1810. (See Nicholson's Philos. Journal.)

The fat or oil which is left in the pan after making calves-feet jelly, if taken and put into a jug or bowl, and allowed to remain for some months, what swims on the surface may be skimmed off, put into a small phial, and kept there for some time; this will be found to be a very fine kind of oil, at least it has the appearance of being so.

A French chemist, of the name of Jodin, prepares an oil, adapted for the use of watch-makers; it resists the cold to a considerable degree, but in time will become green at pivot holes, like most other oils. Olive oil freezes at 38° or 36° of Fahrenheit's thermometer; but if put into an open glass phial, and exposed to the sun-shine for a little while, it will not be apt to freeze till the thermometer is down to 21°.

As the amount of friction, even in the best clocks, in a great measure depends upon the oil, with which the various parts are lubricated, the following information may be considered of some importance. Colonel Beaufoy states, that olive oil may be freed from its mucilage, merely by exposure to the rays of the sun for one or two years.

Chevereul, an eminent French chemist, recommends another process for the same purpose. To effect this, he mixes seven parts of alcohol with one of oil, which must be heated in a flask almost to boiling; the lighter fluid is then decanted, and on being suffered to cool, a little portion of fatty matter separates, which is to be removed. The alcoholic solution must be evaporated to one-fifth of its bulk, and the fluid part of the oil will be deposited colourless, tasteless, and free from smell. This oil seems much like what was called Arabian oil, lately (April, 1825) exhibited in Edinburgh. The printed description given with it, gave neither name of an inventor nor any place of abode, a circumstance somewhat extraordinary, and unless a great quantity of it was to be taken, none could be purchased.

Of old, watch-makers were taught not to allow the small phial, which contained the olive oil, to stand even in the light, far less to be exposed to the rays of the sun, because this deprived it of its yellow colour, which was considered to be a quality of the goodness of the oil. And now, the moderns, by depriving it of that colour, say they improve it.

Oil extracted from poppy seeds, and properly prepared, will remain uncongealed at a very low temperature. Almond, walnut, and hazelnut oil, if freed from the mucilage with which these oils are frequently intermixed, may be tried for watches. It was formerly an object of inquiry, to know when a jar of Florence oil was in a frozen state, which sometimes took place in severe winters—a portion of it remaining unfrozen, was taken out for the use of watch-makers.

We are informed that M. Frederic Schmidt, of Stutgard, has discovered an oil for chronometers, &c. which will not freeze at minus 17 of Fahrenheit's thermometer; does not dry at × 212, and boils

at 512; it is not affected by cold at upwards of 50 degrees below the freezing point. M. S. is of opinion, in which he is confirmed by experiments, that this oil will not be affected under the poles.

The process of pouring the water off between the cork and the neck of the phial, was found to have something in it awkward and clumsy; we therefore got a large phial of about 17 or 18 inches deep, and two inches wide, made with a glass stopper at top, and another at the side and close on the bottom, to let the water out, which answered the purpose extremely well. Also, a few long sort of phials, with ground glass stoppers to each. The tall phial and its stop-cock was found very convenient in the process of washing with water, and letting the water out occasionally, to give room for more fresh and clean water. Oil thus prepared, and afterwards carefully managed, will perhaps be found to be as good as can in any other way be obtained; some of it we prepared in this way, and applied to the pivots and holes of the clock in the Royal Observatory, Edinburgh. This clock was taken down to be cleaned about the beginning of the year 1825, after having gone nearly twelve years; the pivot holes had a little greenish and thick oil in them, but in the reservoirs it was in some degree tolerably fresh and yellow. It is singular that the washing did not deprive it of its yellow colour.

How to preserve the oil, by making such reservoirs as to allow the greatest quantity to be put to the pivots and holes.

To have the pivot holes, so as to preserve the oil for the greatest length of time, with the greatest quantity possible, the following is what should be done, if a little more expense can be allowed:—For those holes, where the pivot ends do not go beyond the surface of the plates, fit into a drill stock, a drill made so as to form something like a drop of fat, when dropped on a table, or such like surface, making the diameter of the artificial drop, to be made by the drill near to four-tenths of an inch or so; in a thick piece of plate brass, make a round hole to receive the drill; the piece of brass must be fixed outside on the frame plates, so as the pivot hole shall be in the centre of the round hole, in order to guide the drill, which must be allowed to cut no further down in the plate, than barely to come to the surface, which should be left to remain, particularly at the pivot hole. A kind of collet might be put on the drill to prevent it from sinking too deep. The drill has the cutting part concave; the inside of the pivot holes may be chamfered a little way by a tool, whose point should be a little on the obtuse side; pieces of hard steel must be screwed on, outside of the plates, so as to cover fully the sinks made by the concave drill, and against the pieces of steel, the pivot ends should occasionally bear; the shoulders of the pivot should be turned nearly away, leaving a sort of cone in their place, and near to the shoulder, or top end of the cone, with the point of a very nice graver, make a slight notch.

The shape of a drop of fat (goutte de suix) at the top of a pivot hole, was a thought, or contrivance, of that celebrated artist, the late Julian Le Roy, and a most beautiful idea it was. (It is to be regret-

ted that it was not adopted in a clock, otherwise very nicely got up, and for public purposes.) Between the hard steel pieces and the top of the dome, formed by the concave drill, there should be a small degree of space; if they are too close, the oil will spread too much over them, and if at a proper distance, the oil will be attracted to a point connected with the pivot ends, gradually draining the reservoirs to supply the waste at the pivot holes.

FROM THE GLASGOW MECHANICS' MAGAZINE.

ESSAYS ON BLEACHING.

By James Rennie, A. M. Lecturer on Philosophy, &c. &c. London.

No. II.—*Bleaching Apparatus.*

Sect. I.—As many of the most useful improvements in bleaching, consist in ingenious inventions of machinery and apparatus, by means of which the chemical agents employed are economised or rendered more efficacious, it would be unpardonable in an essay of this kind to omit their consideration. Such improvements also often depend on a minute acquaintance with the chemical composition of bodies; and inconveniences, which previously could not have been foreseen, may, by a skilful chemist, often be avoided, or at the very least explained; and nobody need be told, that when a difficulty is once understood, it is half overcome. A good instance, among others, of the use of chemistry, as it regards merely the apparatus for bleaching, may be seen at page 24 of the present number.

It is, however, no easy matter to obtain accounts of these, as the inventors commonly conceal their improvements in order to benefit by them; and it is usually a considerable time after an improvement of this kind has been made, that any account of it is given to the public. When patents, indeed, are taken out for such inventions, we can obtain descriptions of them from the specifications, but patents are not always sought, even for improvements of much importance, and in this case we must be contented to remain ignorant of their existence till they come into general use. I shall not take time to describe such machinery and apparatus as have now been disused, but shall confine myself to the consideration of what is at present employed by the most enlightened bleachers, so far as I can obtain the requisite information; and shall, for an estimate of the comparative advantages of the old and new apparatus, refer to Berthollet, Rupp, Des Charmes, Parkes, and the article Bleaching, in the Edinburgh Encyclopedia.

The apparatus differs according to the sort of goods, which are to be bleached; but I shall restrict myself here to an account of that used for linen, and heavy cotton goods; leaving such parts as are peculiar to the bleaching of wax, wool, silk, and paper, till I come to treat of the processes which are used for these substances.

As it is indispensable in good bleaching to have goods thoroughly washed at several stages of the process, and as to perform this manually would be both troublesome and expensive, particularly in works of great extent, several contrivances have been fallen upon for the ready performance of this operation on the large scale. The principal of which are the wash-stocks; and the dash-wheel and squeezers.

A machine, called the wash-stocks, is chiefly used in Scotland and Ireland. It is made on the same principle as the fulling mill, and differs from it but little. Two beams of wood are collaterally suspended by pivots upon a frame, so that they can move freely backwards and forwards. In the lower end of each beam, and almost at right angles with it, is mortised a piece of wood called the stock, which at one end is irregularly sloped. The cloth is put in a frame, or box, of wood, (elm is best,) into which runs a copious stream of water; and the stocks, with their sloped end inwards, play upon the cloth and gradually wash it. The cloth, during the process, is frequently turned, in consequence of being beat by the stocks against the end of the box containing it, which is of a round form. The stocks may be put in motion by a power from a steam-engine, or by a water-wheel, either with cranks or wipers, and ought to make from 20 to 30 strokes in a minute. (Ramsay.)

The dash wheel and squeezers are more recent contrivances for the same purpose, and are generally used in England and some parts of Scotland. The dash-wheel is a water-wheel, about six or seven feet in diameter, and two or three feet wide, which is closely boxed up all round. The inside is divided by wooden equi-distant partitions into four compartments, into each of which is a lateral opening, through the frame work for introducing the cloth. There are also small holes for the purpose of admitting and draining off the water used in cleansing, from the goods. For the purpose of introducing the water, there is sometimes an open circle made laterally near the circumference of the wheel, into which a water pipe is made constantly to play. This circle is crossed with numerous wires, (which should be made of brass,) to prevent the escape of the cloth during the process. While the wheel revolves, the cloth is raised up in one part of the revolution, and by its own gravity it falls down in another; and an agitating motion is thus produced, which proves very effectual for washing the cloth, while at the same time it does not weaken nor injure its fabric. The dash-wheel ought to go at a velocity of about twenty revolutions in the minute, which is by much too quick to serve at the same time the purposes of a water-wheel; a strong objection where it is necessary to economise the disposable water. In the neighbourhood of London they do not make their dash-wheels with close frames, but of sparred work, upon which the water plays freely from a pipe terminating near the upper circumference, whose mouth is flattened so as to make the aperture wide and narrow. (Ramsay.)

The squeezers, as they are called, form a necessary appendage to the dash-wheel. By these, the water is pressed out after the washing is completed. They are constructed with a pair of wooden rollers

super-imposed upon one another, between which the cloth is made to pass, and is by their pressure freed of its water. The lower roller receives its motion from a mill or steam-engine, and the upper is pressed down upon it by means of levers, in the construction of which the mill-wright will judiciously consult existing circumstances. The frame in which the rollers run, is neatest and most durable when made of cast iron. The rollers themselves should be made of elm, beech, or sycamore. (Ramsay.) A large press is sometimes used in place of squeezing rollers, and is a much more expeditious mode of management, but cannot act so equally as the rollers. (Parkes.)

The machine used for washing in France, and other parts of the continent, has more resemblance to the wash-stocks than to the dash-wheel. As in the former, a trough is constructed of elm for containing the goods, holes are made in it for the egress and regress of water, and rammers or pestles of beech, which pass through the upper part of the trough, are alternately raised and let down by tripping pieces fixed on a revolving shaft, and working in mortices made in the beams of the rammers. An ample description of this machine may be seen in Des Charmes.

For the steeping of goods after the first washing, a large circular vat is used, called a sieve; which may be made of almost any kind of wood; as, chestnut, oak, or fir. Oak has the advantage of not shrinking or contracting so soon as fir; but if fir be used on account of its cheapness, care must be taken to avoid using the white deal, which transmits water like a sponge, and to select the yellow in preference; as on account of the resin it contains, it undergoes less alteration in the fluid. If the use of white deal or other spongy wood cannot be avoided, it will be proper to paint the vessel within and without with several coatings of white lead. Melted pitch, tar, or a mixture of yellow wax and resin, may be also used with advantage for the purpose of coating. Care must be taken that the sieve have no cracks or splinters, which might endanger the tearing of goods in taking them out, because the fermentation causes them to expand and press against the sides of the vessels. Belonging to this are two pieces of wood made in the form of a cross, to lay over the goods while steeping. (Ramsay and Des Charmes.)

The goods are boiled in a common boiler, to which a stop-cock is fitted below, to run off the waste ley. Cast iron is what is generally used in the construction of these boilers; for which, the substitution of wrought iron, as in the case of the boilers of steam-engines, would not at all answer, because it is so liable to rust from its attraction for oxygen. The cast iron, on the other hand, always contains a portion of oxygen approaching to saturation, and consequently has its natural attraction for that substance greatly diminished. But it, even, requires particular management to fit the cast iron boilers for the purposes of boiling and bucking. For if *new* boilers are used, the action of the alkaline leys, by their attraction for the carbon of the cast iron, infallibly detaches a portion of the metal, effects a solution, and produces stains in the goods, extremely difficult of removal. To remedy this inconvenience, the manufacturers *season* their cast iron boilers

by boiling in them, for several days, a quantity of waste alkaline ley, by which process a thin crust is formed on the inside of the vessel, that, in future, prevents the immediate contact of the alkali with the carbonized iron. This crust or lamina is probably composed of a carbonate of the alkali which has been used, together with some of the impurities with which the ley may be charged. A similar process of seasoning cast iron vessels must be attended to, when they are used in cookery. The boilers used in bleaching, are made to contain from 300 to 600 gallons of water, according to the extent of business. In order that their capacity may be enlarged, they are formed so as to admit a crib of wood strongly hooped, or, what is preferable, of cast iron, to be fixed to the upper extremity. For the purpose of keeping the goods from the bottom of the boiler, where the heat acts most forcibly, a strong iron ring covered with netting, made of stout rope, is allowed to rest six or eight inches above the bottom of the boiler. Four double ropes are attached to this ring for withdrawing the goods when sufficiently boiled, each of which has an eye for admitting hooks from the running tackle of a crane. Where more boilers than one are employed, the crane is so placed, that, in the range of its sweep, it may withdraw the goods from any of them. For this purpose, the crane turns on spindles at top and bottom; and the goods are raised or lowered at pleasure, by double pulleys and shelves, by means of a cylinder moved by cast iron wheels. The boiler should be fitted with a cover, well fitted, both to economise heat, and to prevent the admission of soot or other impurities, which may produce stains difficult of removal. (Parkes. Ramsay. Des Charmes.)

The bucking apparatus is of considerable importance, and we have already mentioned the improvements of it which have lately been made; as their adoption, however, is not general, it may be necessary first to describe that commonly used. A wooden sieve is made, similar to that used for steeping, and fitted with a false bottom of wooden grate work, a few inches from the true bottom, to keep the goods from coming in contact with the cover of the boiler. Through this cover is a valve to regulate the transmission of the waste ley. There proceeds from the boiler a short pipe slightly bent and placed in a horizontal direction, from the extremity of which arises a vertical pump, for the purpose of drawing the ley out of the boiler and pouring it on the goods. To effect this, a pipe similar to the one just described, runs horizontally from the pump to the sieve, where it throws the ley upon a cone of metal, which is supported by a bar of wood over the middle of the sieve, in order to diffuse the ley equally over the goods. The pump with its two pipes is not unlike the letter E, without its middle horizontal line; the sieve and boiler may be conceived to be placed in its bosom. This apparatus, which is the invention of Mr. John Lawrie of Glasgow, is certainly much more ingenious and convenient than that formerly used for this purpose; but it is greatly inferior in simplicity to that which I shall now describe.

I have not learned who invented the whale boiler, but it is an invention of great utility, and the principle upon which it is constructed is extremely simple and obvious. It consists, like that last mentioned,

in a common cast iron boiler and a wooden sieve, for containing the goods, but wants the pump, to work which, when the former is used, renders the process both tedious, laborious, and expensive. Within the sieve is fixed a false bottom perforated with holes, or made of spar work, for the ready transmission of the leys. From the middle of this bottom arises a pipe or flue, extending to the very top of the sieve, and in which, of course, the cold ley stands at the same level as in the boiler; but when it begins to boil, it immediately ascends through the flue with such force as even to rise above the brim of the sieve. Here it is stopped by a concave plate of sheet iron resembling an umbrella, which is suspended over the flue, and striking against this, by the impulse of the ebullition, it is equally distributed over the surface of the goods at the top of the sieve. Aided by the temperature to which it has thus been brought, the ley gradually permeates the whole of the goods in the sieve, and, reaching the perforated bottom, repasses into the boiler, whence it is again thrown up into the flue, and follows the same routine as before. This process is continued till the goods are judged to be sufficiently bucked. The importance of this ingenious contrivance requires no comment from me; it is likely, I think, in a short time entirely to supersede the other. Des Charmes seems to have been very near the discovery of this contrivance; for, in describing his clumsy boiling apparatus, he says, (page 312,) that the boiler must be fitted with a cover held down by cramps to prevent its being raised by the force of the steam caused by the ebullition, which stream of hot ley is "by these means *compelled to re-act* on the goods in the boiler." (Parkes.)

ENGLISH PATENTS.

To David Gordon and William Bowser, Iron-manufacturers, both of London, for coating iron with copper, or with alloys, of which copper is the principal ingredient, dated Feb. 26th, 1825.

The specification of the above patent, as published in the *Repertory*, is too prolix for our purpose, and the notice of it in the *London Journal of Arts and Sciences* does not satisfy us; we shall therefore make an abstract, and such remarks as may appear to us pertinent. The patentees state, that their "invention consists in the discovery made by them, that a clean surface of iron, brought to a white, or welding heat, or near thereto, is disposed chemically to unite with, and firmly to coat or plate itself with melted copper, into which such iron may be plunged, or on having melted copper poured upon, or over such surface of heated iron." "And in the further discovery made by them, that the union and adhesion of copper and iron occasioned in the manner aforesaid is so perfect, that plates of their patent coppered iron, when malleable iron is used, may be rolled out to a considerable degree of thinness, and may, by hammering or other means, be manufactured either in a cold or a hot state, into a vast variety of useful

articles, either completely, or partially covered with copper." The method which they recommend for heating the iron, and for melting the copper, is to construct two reverberatory furnaces, such as are in use in iron and copper works, so close to each other, that their ends shall be in contact; these furnaces are to be furnished with close fitting doors, and with dampers in the flues, made with great accuracy, so that the admission, and exit of atmospheric air, may be under the most perfect command; and that the air which has been deprived of its oxigen, by supporting the combustion, may, when required, be detained within the furnace. This is to prevent the oxidation (*rusting* or *scaling*) of the plates of heated iron. Great care is also to be taken that all the air admitted shall pass through a bed of ignited fuel, that it may be deprived of its power to oxidize (rust) the metal.

Between the two furnaces, there is to be constructed a sliding door, sufficiently large to admit of the heated iron being passed through, into the furnace containing the melted copper, into which they are to be plunged, and held down from one to fifteen minutes, according to the nature of the article, and the thickness of coating required. The iron is sometimes to be coated by pouring the copper upon its surface by means of ladles. For coating sheet iron on one side they propose to weld the edges of two plates together, then to treat them as single plates, and afterwards to clip off the welded edges. Another method proposed, is to bend up the edges of the plate, so as to form a tray, which may then be placed upon the melted copper, when the under side only, will be plated; otherwise they put into the tray thus formed, the quantity of copper which is allowed for the coating, in which situation it is to be fused, and made to adhere to the plate. Cast, as well as malleable iron, is to be coated by this process; and to prevent the oxidation, they sometimes dip the iron into rosin, or some similar material, which, they state, will be wholly evaporated before the iron acquires the requisite high temperature.

Charging holes are to be made in the furnaces, which holes are to have close fitting doors, lined with fire brick; through them the clean iron to be coated, or the copper to be melted, may be passed, when they are to be closed perfectly. Furnaces of other constructions, it is stated, may be used, as the form or nature of these, make no part of the patent; this consisting not in the apparatus employed, but in the end attained, namely, the complete coating of the iron with copper.

Appended to the specification in the Repertory are the following

OBSERVATIONS BY THE PATENTEE.

From the observation which Mr. Bowser and myself had made upon the very difficult operation of brazing my portable gas lamp-reservoirs, we were led to believe that iron might be coated with copper, and, having erected a very small furnace, we completely succeeded in coating small sheets and bolts in a sufficiently perfect manner. But as we have neither the opportunity of erecting sufficiently large furnaces, nor the command of large rolling mills, both of which would be requisite to turn the invention to much practical use, we have determined,

instead of ourselves forming an establishment for the manufacture of the articles, to grant licenses for the use of the invention upon the payment of a very small sum for the patent right; and in this way, we hope it may become extensively useful, and a national benefit.

We believe the invention suitable for steam, and other boilers, covering houses, making of coal scuttles, for the sheathing of ships, and almost every article where plate iron is used. For ships' bolts we consider it peculiarly adapted, as thereby may be obtained the tenacity of iron, with the durability of copper. A great variety of other purposes might be detailed, to which the invention is applicable, so soon as the manufacture of the article shall have been taken up on a large scale, because the coppered iron may be beat out, and bent, with as much facility, as copper plated with silver.

Since writing the above, my attention has been called by a friend, to an account given of the patent, in a contemporary publication of last month, the editor of which, has thought fit to put in italics the words "has a great disposition to unite chemically with melted copper," which is an incorrect quotation, and to criticise the expression, but in a manner which proves that he does not know the real meaning of the word "chemically."

With regard to the paragraph at the end, wherein the editor states that he has no hesitation in calling the two patents of Mr. John Pool, in the year 1816 and 1822 "*the same*" as the above recited one, I have only to request *any one capable of judging*, to read the three specifications, when I am sure *he* will find them *totally different*.

DAVID GORDON.

33, Cornhill, London.

Observations by the Editor.—We have but little interest in discussing the correctness of the opinions of Editors or of Patentees, on the other side of the Atlantic; but it becomes a duty so to do whenever our observations may prevent their erroneous conclusions from producing error in opinion, or in practice, among ourselves. That the patentees may have coated iron with copper, and have applied the iron so coated to various useful purposes, we have no doubt; but that they made the discovery, "that a clean surface of iron, brought to a white, or welding heat, or near thereto, is disposed chemically to unite with, and firmly to coat or plate itself with melted copper," we certainly do not believe. The fact that there is an affinity between iron and copper, is known to every one who has any claim to the name of chemist; there are but few treatises on chemistry in which the alloy of copper and iron is not mentioned; bells formed of this alloy have been cast in great numbers in the city of New York, and probably elsewhere; and long before the time of the editors, or of the patentees of the present day, the common blacksmith brazed (soldered) pieces of iron together, by means of copper, when something more tough than brass has been thought necessary; and although the smith was no chemist, he was, in this case, performing a chemical operation.

Mr. Gordon has, we think, made a fair *hit* at the editor of the *London Journal of Arts*, who denies that the union of the two metals is a

chemical union, and presumes that the patentees "have found out, that when iron and copper are heated to certain temperatures, and brought into close contact, the particles of the two metals are more susceptible of being mutually affected by the abstraction of cohesion, than under any other circumstances; and taking advantage of this knowledge, propose, under those very circumstances, to perform the plating process."

We confess that we do not know any thing either of mechanical or of chemical philosophy, which will enable us to understand the above illustration; but we write for practical men, and cannot afford room to discuss this point, as it would not interest them; and for our scientific readers it is unnecessary. To the former however we will say a few words upon the difference between those effects which are chemical, and those which are mechanical; but these shall be reserved for another page, and we will place our observations under the head of "The Artisan."

Gordon and Bowser believe their invention suitable "for the sheathing of ships;" for ship's bolts, they "consider it peculiarly adapted." These gentlemen appear not to know, or not to have considered, the galvanic action which would result from this combination of copper and iron, and which would inevitably, and in a short time, destroy the sheathing, and the bolts so used, in consequence of the rapid oxidation of the iron. The incompatibility of copper sheathing and iron bolts had been observed long before the discovery of galvanism; the action of this power will not be, in the slightest degree, prevented, by the close contact produced in the operation of coating.

We have examined the patents of Mr. John Pond, and confess that we think, with the editor of the Journal of Arts, that they are very similar to that of Gordon and Bowser. The manipulations are in some respects different, but the end is in general the same. Pond covers an ingot of iron, &c. with copper or brass on one or both sides, and rolls the ingot afterwards into sheets; whilst Gordon and Bowser propose, generally, to plate the iron after it is rolled; still the iron is covered with a coat of copper or of brass, and that, in consequence of the *chemical* union of the metals. Pond mentions the coating of ornaments made of iron, by dipping them into fused brass or copper, and striking them with a hammer, on taking them from the melting pot, to remove the superfluous metal. The iron is first to have its surface cleaned, and then covered with sal ammoniac and borax. It appears to us that this process might be advantageously followed in many cases, but particularly on ornaments of cast iron.

Specification of the Patent granted to WILLIAM DAVIDSON, *of Gallougate, in the city of Glasgow, Surgeon and Druggist, for a process or processes for bleaching or whitening bees-wax, myrtle-wax, and animal tallow.* Dated August 1, 1826.

To all whom these presents shall come, &c. *Now know ye*, that in compliance with the said proviso, I, the said William Davidson, do hereby declare, the nature of my said invention, and the manner in

which the same is to be performed, are particularly described and ascertained in the following description thereof, (that is to say:)—I combine liquefied bees-wax, myrtle-wax, or animal tallow, with oxymuriate of lime, oxymuriate of magnesia, or an aqueous solution of either of them, by stirring the same with a wooden or other spatula, or otherwise in any suitable vessel, and I decompose these salts by some acid, which has a greater affinity for the lime, or magnesia than the oxymuriatic acid; such, for instance, as sulphuric acid. For melting the wax or tallow I use an iron vessel, lined internally with lead, or any other suitable vessel, and heat it by means of a common furnace, or by steam, applied in any way that may be considered most advantageous. I then combine in this leaden or other suitable vessel, about one hundred and twelve pounds weight of liquefied bees-wax or myrtle-wax, with about an equal weight of a solution of oxymuriate of lime, heated to about the temperature of boiling water and having allowed the mixture to become a little consolidated, I add to it from fifty, to one hundred ounces of sulphuric acid (of the usual mercantile strength, say of specific gravity 1·8485) previously diluted with about twenty or thirty times its weight of water, and boil them, whilst agitation with a spatula or otherwise is employed, until the lime is completely separated from the oxymuriatic acid. The solution of oxymuriate of lime which I employ for bleaching bees-wax, and myrtle-wax, is made by dissolving from about fourteen to twenty-eight pounds weight of the salt in about one hundred and twelve pounds weight of water.

For bleaching animal tallow, I generally use from two to five pounds weight of the oxymuriate of lime to one hundred and twelve pounds weight of tallow, with a proportionate quantity of water to dissolve the salt, dilute the acid, or supply the loss by the subsequent boiling. However, these proportions of oxymuriate of lime and sulphuric acid for bleaching bees-wax, myrtle-wax, and animal tallow, are not absolute, but a greater or less quantity of the oxymuriate of lime and sulphuric acid is necessary in proportion to the greater or less quantity of colouring matter in the wax or tallow. In those cases where the wax or tallow is not sufficiently bleached by the process, I repeat it.—*Repertory of Pat. Inven.*

Specification of the Patent granted to Abraham Henry Chambers, *Esq. of Bond-street, in the County of Middlesex, for an improvement in the manufacture of a building cement, composition, stucco, or plaster, by means of the application and combination of certain known materials hitherto unused (save for experiment) for that purpose.* Dated January 15, 1821.

To all to whom these presents shall come, &c. &c. *Now know ye*, that in compliance with the said proviso, I the said Abraham Henry Chambers, do hereby declare that the nature of my said invention,

and the manner in which the same is to be performed, are particularly described and ascertained in the following description thereof: (that is to say) I do hereby declare that my aforesaid improvement consists in the use and employment of certain burnt or vitrified earths, or earthy substances, and of certain metallic and other substances, which I cause to be ground, or otherwise reduced to powder, and then to be mixed and incorporated with the lime, for the purpose of producing mortar, plaster, stucco, or building cement, by whatsoever name it may be called or distinguished, thus producing a most perfect and efficient cement from artificial pozzalana. The earthy substances which I prefer for this purpose are all those kinds of clay or loam that are capable of becoming vitrified and intensely hard by exposure to a strong fire; consequently chalk and all the various lime stones and other earths, which become soft, friable, and capable of slacking or falling to pieces when exposed to heat, are unfit for the purpose aforesaid, but flint, or flint stones, or pebbles, may be used with advantage, notwithstanding they do break and fly into pieces when heated. A trial on a small scale will, however, convince any one whether any particular earth, or earthy, or stony matter is proper, to be used, which will be ascertained by exposing it to a very strong heat, when if it runs into a slag, or vitrifies, or becomes excessively hard, it may be used, but if otherwise, it must be discarded as unfit for the purpose. The proper kind of earth being thus selected, it must be heated either in the interior of a brick or other kiln, or in a kiln or furnace, formed for the express purpose, and which may be built either of bricks, or formed of earth, with proper vent-holes or flues, until it becomes completely vitrified, or reduced to a state of hard, black, or glassy slag, which in many cases will be found sufficiently hard to strike fire with steel. The harder and more vitrified the materials become, the better they will answer for my aforesaid improvement. The vitrification of some kinds of earth will likewise be occasionally assisted and improved by mixing refuse or broken glass, or even sand and wood ashes, before it is exposed to the action of the fire. I claim likewise the exclusive privilege of appropriating other slags, or vitrified materials which are not produced for the express purpose, to my aforesaid improvement, such as those which come from the furnaces of smelting-houses, glass-houses, foundries, steam-engines, or other boilers, and all materials reduced to a state of vitrification by intense heat. The whole of the aforesaid materials, whether produced for the particular purpose, or obtained from any of the before-mentioned sources, and whether consisting of vitrified earth, metallic, or other vitrified slag from furnaces, or burnt flint, or flint-stones, must be bruised, pounded, or ground by any of the usual, accustomed, and well-known methods, until it is reduced to such a grit as will be convenient and necessary for the formation of the particular sort of mortar, stucco, plaster or cement, which may be required for this purpose; it must be passed through such wire-screens, or sieves, as will produce the necessary fineness or quality, and being so separated into different qualities, it may be put up into casks, or otherwise preserved for use, and is a most perfect artificial pozzalana.

The manner of using the above material or materials is to mix it with well-burnt lime, instead of the sand usually employed for the formation of mortar, stucco, plaster or cement, water being added as usual, until it is of the proper consistence to be used; or the artificial pozzalana, or above materials may be mixed with quick lime completely pulverized and sent in casks or other packages ready to be used with the addition of water only. In this latter ease, it will be necessary to keep it from moisture or exposure to the open air until the time of using it. The proportion of quick lime that must be added to the above materials will depend entirely upon the goodness or strength of the lime that is used. In general, one measure of good lime will be sufficient for, from three tô five measures of the aforesaid materials, but this must be regulated by the work for which it is intended, and will be readily ascertained by a little experience. I hereby further declare, that another part of my said invention and improvement consists in the use and appropriation of marble of various colours, and of various coloured bricks, when highly burnt or vitrified, and reduced to fine powder for the purpose of producing all the variety of colours and shades required to imitate stone, and highly polished wood and marble. And lastly, I claim the exclusive right and privilege of using vitrified earth, and the aforesaid other materials for the purpose of mixing with lime, or plaster-of-paris, to cast figures, ornaments, and mouldings of every description.

In witness, &c. [*ib.*

Patent granted to James Ashwell Tabor, *Gent. of Jewin-street, Cripplegate, London, for means of indicating the depth of water in ships and vessels.* Dated Dec. 14, 1825.

Mr. Tabor's method of indicating the depth of water in ships, is by floats, which rise or fall in copper cases, placed close to the kelson, and which, by wires and small chains, turn the hands or indexes of a dial on the upper deck, according as the water in the hold is higher or lower.

As the ship will incline by rolling sometimes to one side and sometimes to the other, Mr. Tabor uses two copper cases, and two hands to his dial, each of which hands moves unconnected with the other, and one of which indicates the depth of the water at the larboard or left side of the ship, and the other that at the starboard side. The copper vessels, in which the floats are placed, are fixed one at each side of the kelson, and pass down close to the timbers through the limber boards, and are represented in the drawing of the specification as rising a small space above the kelson; at the top of each of these vessels a pair of rollers are fixed close to each other, between which a small chain passes, that connects the float which lies in that vessel with a wire, which ascends through all the decks to another small chain, that passes round a pulley on the part of the axis of the index, which is appropriated to that side of the ship. Each float has thus

separate vessels, wires, chains, and indexes; but, in order to combine the two indexes in one dial, the axis of one of them is hollow, and that of the other passes through it, each axis having its own index and pulleys, and moving independently of the other; as the chains and wires of the floats require to be counterbalanced, each axis has a second pulley on it, smaller than the first above-mentioned, round each of which a small chain passes, that descends, on the side opposite to that where the wires are placed; to this is attached a weight sufficient to balance the wires and the other chains; this ascends and descends in a vessel placed to receive it below the upper deck; the small chain being guided to it by a pair of rollers, placed above the vessel, between which it passes, in the same manner as the float chains pass between their rollers above the lower vessels, as before described.

The pulleys connected with the chains of the balancing weights are made smaller than the other pulleys, to cause the weight to require a less space for ascending and descending. The figures on the dial, will, by this arrangement, show the height of the water in the lower vessels belonging to the floats, according as the indexes connected with these floats are moved round, and point to them. Lastly, it is stated by the patentee, that springs might be used to counterbalance the wires, &c. of the floats, in place of the weights; but they are objected to, on account of their being liable to rust. [*ib.*

"UPWARD FORCES OF FLUIDS."

Remarks on Mr. Genet's "Memorial, on the upward forces of fluids," and also upon Dr. F. Pascalis's communication on the above subject, published in Silliman's Journal. By the Editor.

We, some months since, copied from the "Boston Journal of Philosophy," a notice of a publication by E. C. Genet, entitled a "Memorial on the upward forces of fluids;" to this notice we appended a few remarks, but did not intend ever again to bring Mr. Genet's reveries into public notice, because we viewed them as *harmless*, from their not containing any thing which could mislead an individual acquainted with the first principles of mechanical philosophy; and certainly we had not the wish, had we possessed the power, to prevent the admiration of the ignorant, at the stupendous effects to be produced by these newly discovered mechanical powers, the "upward forces of fluids." What a man publishes to the world, is a fair subject for criticism, unless it be too feeble, or too ridiculous to call forth serious investigation. Need we cite examples, to show that men, in many respects intelligent, have propounded the most absurd doctrines, and supported the most ridiculous projects, particularly upon the subject of mechanics? such instances are too numerous, and too well known, to require exemplification. From our intended silence, as regarded any further notice of the work of Mr. Genet, we have been diverted by an article published in Silliman's Journal for October last, written "by Felix Pascalis, M.D. President of the American Branch of the

Linnæan Society of Paris, &c. &c." When Richard Brothers prophesied, Nathaniel Brassy Halhed, M. P. testified to the inspiration of the fanatic; now, although we do not mean to say that Mr. G. is *as* crazy as Mr. Brothers, or that the Dr. is *as* learned as Mr. Halhed, we yet think that there is a degree of appositeness in the two cases, which must strike, on the instant. The Dr. thus commences:—

"It is often the case, in this age of much writing and printing, that Reviewers, or Editors of Journals, have the exclusive power to establish the reputation of an author, if they choose, or to deliver over his book to neglect and contempt. They may also raise a work much above its true merit and value. From this result there is not much harm, because public opinion must finally decide and award justice to the author. There is still a degree of retardation to the progress of science, of taste, or of other desirable improvements; but what is worse, is the fallen fortune of a book in the market. When it has once been lowered in the hands of wholesale or retailing venders, it never can be well restored; and what should command the sober and cautious attention of the readers, is, that they are themselves *duped*, in as much as not being aware of the comparative merits of the author and his reviewer, they take it for granted, that it is the duty of the latter to be impartial, while he is not even qualified to bestow either praise or censure.

"To these observations I was led, by reading, lately, much incorrect criticism, and many unfounded remarks, against Mr. E. C. Genet's Memoir on the upward forces of Fluids, on which I wrote something in the preceding number of this Journal. I hesitate, however, to be myself his encomiast, but I would rather be condemned to study again my experimental and mechanical philosophy, than to condemn any portion of it, much less his departure in part from the Newtonian philosophy. Have we not proofs enough in nature, that if there are many of its elements under centrifugal agency, there are others under a centripetal force?" * * * * * * *

The Dr. concludes with the following observations.

"Thus far we have succinctly described the æronaut of Mr. Genet, offering at the same time a view of all his plates. We are satisfied of the novelty and ingenuity he has displayed in each of his experiments and applications, but this remark is particularly applicable to the part upon which it may be said, that the whole labour of theorists and machinists has been during nearly 60 years concentrated, to find out the means of directing and regulating the course of a balloon after it is launched in the atmosphere.* We have abstained from the privilege of reviewers, who might have caught some cause of censure and criticism, although we are aware of a few inaccuracies, and of some material objections that might be offered against the theories of the author, as well as with respect to his mechanical applications. We think it better and more honourable to keep these under consideration, until he can avail himself of a farther revisal, and until the public opinion may have had a proper chance to be formed. There is no doubt but a sufficient number of qualified *judges* and experimen-

* Were attempts made to direct balloons nearly 20 years before they were invented?

ters may be found in this country, where mechanical pursuits and ingenuity are so often successfully applied to public improvements. A different course would appear to us exceptionable, inasmuch as Mr. Genet is not a philosopher of common stamp; nor has he departed from any principle in hydrostatics or in dynamics, that could not be supported, even, with some exception, to the Newtonian law of gravitation. The right of a patent which Mr. Genet has affixed to his discovery, will sufficiently protect him against any improper invasion, as well as the public mind against any dangerous error or application that could be apprehended from his speculations, and we should add, against unqualified witticism pointing at ridicule, or condemning his memorial to be dead stock in the booksellers' shops. 'Quæque ipse miserrima vidi.'"

Between these quotations, there are about eight pages of letter press, and four copper plates; the letter press is an abstract of Mr. Genet's book, intended to illustrate the contrivances, represented on the plates. We regret that we have not one of the latter, to manifest the truth of the Doctor's observation, that "Mr. Genet is not a philosopher of common stamp," and also that "*qui dit docteur, ne dit pas toujours un homme docté, mais un homme qui devroit être docté.*" Either of the plates would answer our purpose, although we should certainly prefer the third or fourth, as they appear to rise, by a regular climax, into the upper regions of absurdity. We should not be anxious, had we the power, to *condemn* the Doctor, "to study again his experimental and mechanical philosophy;" a shorter, and perhaps a more certain way to render himself one of the "qualified *judges*," would be to become an "experimenter", and to construct an *hydronaut*, or an *aeronaut*, upon the principles contained in the 'memorial' of his friend Genet; he will then be perfectly able, in this one case at least, to determine the question, "who's the *dupe?*"

Perhaps some of our readers may be provoked to release a copy of the memorial from its state of condemnation in the hands of the booksellers; for the satisfaction of such, we should not think any thing else necessary, than the possession of the work: but to those who may not pursue this course, we advise a reperusal of the remarks from the Boston Journal, p 41, of our last volume, to which we now add some further account of the hydrostatic ship, or boat, which Mr. Genet denominates an HYDRONAUT, (memorial p. 62) the machinery of which is to work "with a velocity of action, and uniformity of movement, superior to the best and most powerful steam boat engine." Before describing his newly contrived propelling machinery, Mr. G. gives some information relative to the steam engine, for the purpose of running a parallel between it, and his own newly discovered power. In doing this, he furnishes intelligence respecting the derivation of force in the steam engine, which is new to us, although we have constructed, and used this instrument, as well as studied, and explained its operation. We are told by him, that Mr. Watt has availed himself of the downward force of the piston, and weight of the steam engine, and that the force is created by the falling of the weight and piston, into a partial and momentary vacuum, and that its power is determined by the incumbent weight, and by the atmospheric

pressure. Our own conclusions upon the subject, were so unlike those of the "philosopher of no common stamp," that we had believed, and even publicly taught, that the weight of the piston, and of the other moving parts of the engine, served only to abstract from its power, and that provided they had the necessary degree of stability, the lighter they could be made, the better they would answer in practice. Instead of supposing that the pressure of the atmosphere, was necessary to the action of Mr. Watt's engine, we had taught that its structure might be simplified, and that its action would be more powerful, could it be worked in vacuo. Here is a great discrepancy; either we, or this uncommon philosopher, together with his encomiast, must be in the wrong, and need, in sober truth, to study again our experimental and mechanical philosophy. We are giving a fair, candid, and ungarbled statement of the doctrines taught by Mr. G. and let "qualified *judges*" decide between us.

The following question, with its answer, are from p. 61 of the memorial. "How does the engine perform that operation—how does it create that *vis motrix*, that moving force, which is the mechanical life of the machine? By the alternate increase and decrease of temperature, which produces in the cylinder two kinds of fluids, the one *gaseous*, the other *atmospheric*, by the means of which the piston raises and falls." We had fancied, that the *vis motrix* was caused by a vacuum on one side of the piston, and an elastic, but condensible vapour, on the other, and that the exclusion of *gaseous* and *atmospheric* fluids was of essential importance to its action; but we really do not understand the nomenclature here used by Mr. G. and of course, are not, in this case, qualified judges; we never learned that a vacuum was a gas, or that the vapour of water, was atmospheric.

But to the *hydronaut*. Mr. Genet may either not understand, or may have committed some mistakes in his explanation of the steam engine; he may have watched its *motions*, without having become familiar with its *disposition*, yet in his own child we might expect to find him perfectly familiar with both; we however, are a little inclined to suspect, that in this latter case, he knows more of the *disposition*, than of the *motion*.

The *proposed* moving power of the hydronaut, consists of two hollow copper vessels, called *hydrostats;* they are to be cylindrical, with conical ends, perfectly closed; these are to be suspended upon a beam, 24 feet long, resembling that of a steam engine, and are to hang below it, similar to a pair of scales upon their beam. These hydrostats are to be contained within two cylinders which stand under the beam, and in which they may freely rise and fall, when the beam vibrates. These cylinders are to be open at top, and to have a valve in the bottom of them, to open a communication with the water in the river; by some means, (what means we cannot discover,) water is to be made to flow alternately in, and out of these cylinders; that which contains water, will have the *hydrostat* immersed within it, forced up by its buoyancy, that at the opposite end being allowed to descend, in consequence of the removal of the water; and so on, *ad infinitum*. The machinery by which it is intended to remove the water, is to be worked by the same beam. This machinery consists, principally, of two pumps, oddly

enough, called *air* pumps; their piston rods are attached to the beam, they being placed within the main cylinders; to the beam is also appended the apparatus for opening and shutting the valves; a piece 14 feet in height, ascends from its centre, and from the end of this, a rod passes which is to act upon a crank, and give motion to the paddle wheels, whilst by the intervention of a *large wheel turning a pinion*, the velocity is to be increased. Should any one wish for a model of this machine, he may make it, by suspending an egg shell upon each end of a small scale beam, these will be his *hydrostats;* then by taking two glasses of water, and passing them alternately upwards, against the shells, he will cause the beam to vibrate; and if he can then only contrive to attach to the beam, something which will relieve his hands from the task of moving the glasses, he will have constructed a perpetual motion, exactly upon the principle of that of Mr. Genet. Should he be at a loss to see how this is to be done, we must refer him to the inventor, as we cannot direct him, even with the aid of the engraving, and of the book. "So the *hydronaut* will navigate, until it is stopped"—say the gentlemen concerned; we, however, feel inclined to transpose the sentence, and to say, "so the hydronaut will stop, until it is navigated."

We have extended these remarks to a greater length than we had designed, or than the intrinsic merits of the subject would justify; but when gentlemen who are members of learned societies, and who are confessedly very clever in particular departments of science, bring the influence of their names, and their talents, to the support of notions the most crude, and which manifest a palpable deficiency of knowledge, in the first principles of the particular branch of science, to which the examination belongs, it would be a culpable neglect of duty in the sentinels of science, to permit them to pass, unhailed. To talk about condemning a man because he has ventured to depart from the Newtonian philosophy, is to talk very feebly; whilst universal homage is paid to the genius of Newton, we know of no one who would pretend to establish a law, upon the opinions of that philosopher. The theories of Newton are as freely discussed in the scientific world, as the theories of any other man. What we understand by a departure from the Newtonian philosophy, is, not a departure from the deductions of that philosopher, but from the mode of philosophizing, by which these deductions were formed; and in this point of view, the case in hand, is a most fearful departure.

Information on the progress made in the various attempts to obtain a spontaneous flow of water, by boring the earth to a considerable depth. Extracted from "An Essay on the art of boring the earth," &c. &c. recently published, and for sale by Messrs. Carey & Lea.

In page 34, of our second volume, we published some account of the operations of Mr. Disbrow, in boring for water in New Jersey. The essay above named is the production of the intelligent corres-

pondent who furnished that account. One principal object of the essay is "to prove that water can be procured by means of the art of boring, in any spot that the borer chooses, and that water may rise above the surface, independently of gravitating pressure." A considerable number of facts are brought forward in support of these opinions, which, if they do not prove the correctness of the theory assumed, serve at least to manifest, that the subject is worthy of more careful investigation than it appears to have received. The reasoning of the author is, we think, too hypothetical, but we should be careful not to permit this opinion to invalidate the facts upon which the reasoning is founded.

The essay contains a notice of twenty-four experiments, made by Mr. Disbrow; for the particulars of No. 1. we refer to the before named communication.

"*No.* 2. Commenced August 7th, 1824, about one mile from well No. 1, 47 feet above the level of the Raritan. Went through 60 feet of soft red shell, and struck the first vein of water—three feet of granite—blue shell—blue rock—at 110 feet came to a rock harder than granite: this rock was about four feet thick; in the centre of which, encountered loadstone; the poles of the borer were so strongly magnetized that a heavy jack-knife could be suspended from them. This stratum of loadstone seemed about 4 inches thick; came to water after passing the adamantine rock, through which the borer could only penetrate from two to six inches a day; went through various kinds of rock, some calcareous and others silicious. The red shell was always found at intervals; and water was almost always obtained either in the stratum, before encountering red shell, or else immediately after it. The strata of clay were never of any thickness, until towards the lowest part of the bore, when, after going through four or five feet of blue clay, at the depth of 394 feet, struck a vein of water, which immediately overflowed at the top, and is now, Nov. 14th, (1826,) discharging two gallons a minute, at the height of 2 feet 8 inches from the ground. This well is tubed to the depth of 194 feet, with a copper tube of one and a half inches diameter. It is regretted that no particular note was taken of the thickness of each stratum of rock as it occurred in this well, as there seemed to be a greater variety in this spring than in any of the others. It was thought to be finished in the winter of 1824, as the water ran above the surface; but it was found necessary to bore deeper. There was an ebb and flow in this well until it was bored deeper. The present tube must have shut out the particular vein that caused the ebb and flow as it is no longer apparent. The temperature of this spring, at the depth of 250 feet, was 52° Fahrenheit; now, at 294, it is 54°; thus adding another proof of the correctness of the opinion that the temperature increases as we get more into the interior of the earth.

"*No.* 3. Mr. Simpson's distillery, New-Brunswick. Began in Nov. 1824, and finished in Feb. 1825. Went through 7 feet of clay, and then 60 feet of red shell, when the first stream of water was struck. At the depth of 140 feet, a thin stratum of loadstone was encountered; the poles were strongly magnetized, but not equal to

that of well No. 2. The rock succeeding the loadstone, was gray granite, for a foot or two, when the red shell re-appeared. At 150 feet, there were indications of copper. This well is 176 feet deep, and cost 440 dollars; is tubed only 18 feet, and discharges two gallons a minute: 52° Fahrenheit.

"*No.* 4. In Dunham's Alley, in New-Brunswick, ten feet above the level of the Raritan. Began it in Feb. 1825. Bored through made ground for 12 feet, and then met with continued strata of red shell to the depth of 208 feet. Water now rises above the surface; but the boring has been discontinued for the present, as *Mr. Disbrow*, to whom this well principally belongs, is too much engaged to finish it. The water is above the surface, but the stream is trifling.

"*No.* 5. Jersey City. April, 1825. Level, 25 or 30 feet. Began to bore in a well 24 feet deep; water in it very brackish. Jersey City surrounded by salt water. Granite from the commencement to the present depth, which is 208 feet. Struck several veins of water after going 146 feet. By inserting a small pump, three gallons a minute can be raised. The water runs over the tube 21 inches, unaided by machinery. They are still boring. Water excellent.

"*No.* 6. Alexandria. Thirty-five feet above the level. Bored 23 feet in common soil, a stratum of iron ore, of about a foot thickness, 11 feet of quicksand and water, 11 feet of sand, 10 feet of coarse gravel, 90 feet of black alluvial, intermixed with wood and fibrous particles, &c.; two feet of gray stone, 96 feet of blue, yellow and gray clay. After getting through this clay, struck a vein of water, which arose to within 36 feet of the top. Bored to the depth of 450 feet, through different coloured clay, with now and then a stratum of coarse sand. Quitted in May, with the intention of resuming it again.

"*No.* 7. Hudson, New-York. Seventy feet above the level of the Hudson. Began in May, 1825; 40 feet clay, 30 of brown sand, 4 hard-pan clay and gravel. Struck a vein of water, which arose 17 feet; 70 feet of black slate rock, mixed with limestone. Still boring.

"*No.* 8. North side of the Raritan, half a mile from New-Brunswick; 80 feet above the level of the Raritan. Began in 1825, in the bottom of a well that was 48 feet deep, and quite dry; 60 feet of red shell; struck a vein of water which gave eight feet water to the well; indications of coal; red shell, and now and then thin strata of gray wacke, to the depth of 250 feet, when water came above the surface, discharging one and a half gallons at the height of seven feet. Cost about 400 dollars, and is tubed 100 feet, with one and a half inch copper tube, connected at intervals of twelve feet, with brass screw joints. These copper tubes cost 50 cents a pound; and the screws are 75 cents a piece.

"*No.* 9. Albany. Began May, 1825. Boyd & M'Culloch, Brewers. Level 20 feet above the Hudson. Began in a 30 feet wall; 11 feet of coarse gravel and hard-pan; 41 feet black slate rock; very little water until after passing a depth of 200 feet of same rock; struck several small veins. At 250 feet encountered inflammable gas. Now 280 feet deep, and water within four feet of the surface.

"*No.* 10. Albany. Waterworks Company. Began in August, 1825. Twenty feet of clay, sand, and gravel; 17 feet hard-pan; struck a vein of water which instantly overflowed at the surface, at the rate of five gallons a minute. The diameter of the bored hole of this spring was eight inches, whereas all the previous ones were from two and a half to two and three-quarter inches in diameter.

"*No.* 11. The same company are now boring back of the Capitol, in Albany, on very high ground, and are now, at the depth of 120 feet, in hard-pan.

"*No.* 12. New York. Manhattan Company. Began Sept. 1825. Level 40 feet above the Hudson. Bored 40 feet in sand and gravel; 60 feet in hard granite; from that depth to 240 feet, occasional veins of water; increasing in quantity as the depth increases; water, when a tube is introduced, now within 30 feet of the surface; discharges 12 gallons a minute, by means of a pump. When down to the depth of 260 feet, the chisel passed a vacuum of an inch; the water immediately sunk one foot; but in the course of a few hours, when the cavity was filled, the water again rose. This has been the case in several wells; boring still continuing.

"*No.* 13. Harper's Ferry. Began June, 1825. Level 12 feet. Very high mountains in the rear. Fifty feet of soft gray slate; 50 feet of granite, but not very hard; occasionally quartz and granite. At 110 feet, touched a fine vein of water: some quartz and granite at the depth of 264 feet. Discontinued for the present, but is to be resumed.

"*No.* 14. Baltimore. Mr. Bosley, two miles west of the city. Seven feet common soil: 33 feet rotten gray rock; 140 feet of the same rock, only harder; struck a vein of water, which arose to within 22 feet of the surface. Some mischievous person having at this time thrown in a piece of steel, it cost a great deal of time, labour, and money to cut it up, it being of 30 inches in length. The boring is going on, and much praise is due to Mr. Bosley for the liberal spirit he has shown in the prosecution of this work under so many discouragements.

"*No.* 15. Horsimus. Eighty feet above the level of the Hudson. Mr. Haight's Carpet Manufactory. Began June, 1825, in a well 30 feet deep, which did not give a sufficient quantity of water, as the machinery was idle one day in six. Bored 30 feet in sand, gravel, and hard-pan. Got plenty of water.

"*No.* 16. New-Hope. June, 1825. Sixty feet level. Eighty feet red shell, 110 limestone. Still going deeper.

"*No.* 17. Philadelphia. Mathew Carey, Esq. Began in a well 48 feet deep, quite dry. Thirty-eight feet of hard granite, and brought 4 feet of water in the well. Object obtained. Granite, therefore, in this case, as well as in the spring No. 5, in Jersey City, is intersected by veins of water.

"*No.* 18. Northern Liberties, Philadelphia. Level 40 feet. Forty-five feet sand and gravel; 145 feet gray granite rock, only varying from soft to hard. Struck several veins of water in this granite. Water at present within 25 feet of the surface.

"*No.* 19. New-York. Corner of Rivington and Columbia streets. Commenced Aug. 1825. By degrees sunk a cast-iron tube, and began in a well 20 feet deep. Ten feet quicksand; 20 feet marsh mud, and clay; ten feet gray clay; stopped at granite. All the upper brackish water is excluded by the tube, and there is a fine flow of water from the junction of clay and granite. This water is excellent, and is pumped up by a small pump.

"*No.* 20. New-York. Broad-street. Mr. Tunis Quick. Four feet common made ground, or street filling, of the consistence of mud; 6 feet of yellow clay; 19 feet gravel and quicksand; 10 feet of gray clay. Came to granite, fastened the cast-iron tube, and water arose to within 7 feet of the surface. Put in a pump; object obtained.

"*No.* 21. New-York, corner of Avenue D, and Fifth-street. Bored through 6 feet of common street filling; 10 feet marsh mud; 65 feet of quicksand and gravel; 15 feet of gray clay. Came to granite, and obtained fine water. Tubed 96 feet. Bore 8 inches diameter. Water within 4 feet of the top.

"*No.* 22. Dry Dock Company, corner of Avenue D, and Tenth-street. Six feet common filling; 10 feet marsh mud; 12 feet quicksand; 53 feet of common shore sand and gravel; 6 feet of hard-pan; 3 feet of coarse gravel. Stopped at the granite, and got plenty of water within 4 feet of the surface.

"*No.* 23. Newark Meadows, Grazing Company. At the junction of Belleville and Newark Turnpike, on the *salt marsh*. Ten feet of marsh mud, and roots; 12 feet of fine quicksand; 36 feet bluish gray clay; 6 feet sand; 20 feet of ash coloured clay. Met with water: bored 20 feet farther in very stiff variegated clay, on the reddish cast. Touched the red free stone, and stopped. Water excellent and soft, and within three feet of the surface. The reclaiming of salt meadows has been a great object obtained. The reclaiming of the fresh water springs is of still higher importance.

"*No.* 24. Allen-street, near Hester-street, New-York. Began in a well 40 feet deep, that had about two feet of brackish water in it. Commenced in quicksand: bored 20 feet: now and then a stratum of gravel: 2 feet clay, 5 feet of coarse gravel and sand. Obtained water, as is always the case, before coming to the solid rock. All the waters of these last mentioned wells are like the water of the old *Tea Water Pump*."

THE ARTISAN.—NO. 2.

Observations on Specific Gravity. By the Editor.

Practical men are daily becoming more sensible of the value of scientific information, in enabling them to pursue their respective arts to the greatest advantage; but appalled at the array of terms which they encounter on the very entrance on the paths of knowledge, and with which they are are not familiar, they retreat in dismay, consider-

ing the effort to advance, as altogether hopeless. To pretend that artisans will, or can, become men of general science, would be ridiculous; but there are particular branches of knowledge, which may be considered as isolated in a degree sufficient to make them attainable, without the necessity of passing through a regular routine of study, whilst by their natural connection with other branches, they will enlarge the mental vision of those who possess them, as assuredly as the ascending an eminence will extend the field of view, to the observing traveller. While attempting to explain these isolated branches of science, it is important to render their utility obvious, by showing their profitable application to the purposes of business. It was under these impressions that specific gravity was selected as a subject for the first number of "The Artisan," a subject which, in accordance with our promise, we now resume. The terms *heavy*, and *light*, are relative; thus, oak is heavy, compared with cork, and light, compared with the metals. In estimating the specific gravities of bodies in general, we have already stated that water is the article with which all others are compared; we may therefore, when treating upon this subject, consider water as the dividing line, and call those bodies heavy, which sink, and those light, which float on that fluid. Bodies sink, when they are heavier than a portion of water, equal to themselves in bulk; and float, when they weigh less than an equal volume of the fluid. Upon the same principles, we may consider ether as a light, and sulphuric acid, (*oil of vitriol*) as a heavy liquid; the former being only about three-fourths, while the latter is nearly twice the weight, of equal bulks of water.

For the methods generally pursued in ascertaining the specific gravity of solids, or of fluids, we must refer to what we have already published upon this subject. We are aware, however, that artisans will not, in general, procure hydrometers, to enable them to ascertain the strength of the spirits, the acids, and the other fluids which they employ in their respective pursuits, and that it is difficult, in most situations, to obtain such as are suitable; but a substitute for them, which will be sufficiently accurate for all practical purposes, may be procured everywhere. In one of our numbers on japanning and varnishing, (vol. 2, p. 102) we have mentioned such a substitute, but it may be well, on the present occasion, to be a little more particular on this point. A phial with a small neck, such as a cologne water bottle, and a pair of scales with small weights, include all the necessary apparatus. A weight should be prepared, which shall be an exact counterpoise for the bottle, and when placed in the opposite scale, will render the weight of the latter, of no importance in the calculations to be made. The bottle should have a mark made on it with a file, upon the narrowest part of the neck. Pure water should then be poured into it, until it just reaches the mark, when the bottle must be placed in one scale, its counterpoise in the other, and the exact weight of the water ascertained; which should be noted down, as this operation need be performed but once. When the specific gravity of any other liquid is required, the bottle, which must first be made clean and dry, is to be filled with it, exactly to the mark, and weighed; when, by having ascertained the weights of equal bulks of water, and of

the liquid in question, we are enabled, readily, to find its specific gravity, by the rule of three; the weight of water, being, in all cases, the first term, 1.000, the second, and the weight of the fluid under trial, the last. Thus, suppose we are essaying *sulphuric acid;* the water we will suppose to have weighed 1920 grains, and the acid to weigh 3456 grains; we then say, as 1920 is to 1000, so is 3456, to the specific gravity of the acid, which will be 1.80, or 1 and $\frac{8}{10}$ the weight of water, which is weaker than it ought to be; an acid of much less specific gravity than 1.85, not being accounted good. Extensive tables of specific gravities, both of solids and of fluids, may be found in most of the works on chemistry, or natural philosophy; we subjoin a few of each, by way of example, selecting those articles most commonly used.

LIQUIDS.		SOLIDS.	
Distilled, or rain water,	1.000	Platinum	20.980
Sea water,	1.026	Gold,	19.257
Milk,	1.032	Lead,	11.352
Sulphuric acid,	1.850	Silver,	10.478
Nitric acid,	1.580	Copper,	8.895
Muriatic acid,	1.194	Iron,	7.788
Brandy (rectified)	0.837	Tin (block)	7.291
Spirits (proof)	0.902	Zinc	6.861
Alcohol,	0.829	Italian marble,	2.716
Ether (sulphuric)	0.739	Lignum vitæ,	1.333
Naphtha,	0.708	Box-wood,	1.328
Spirit of turpentine,	0.869	Shell-bark hickory,	1.000
Linseed oil,	0.940	White oak,	0.855
Sweet oil,	0.915	Red oak,	0.728
Mercury,	13.568	White pine,	0.418

In the above table, if water be reckoned as 1, the right hand figures become decimal fractions; but if water be called 1000, fractions are avoided, and the specific gravities become whole numbers. Thus a measure which would hold a thousand ounces of water, would be filled by eight hundred and twenty-nine ounces of alcohol, or by thirteen thousand, five hundred and sixty-eight ounces of mercury.

Were a person to obtain a bottle containing exactly a *thousand* grains of water, the specific gravity of any other fluid essayed by it, would be that of the number of grains which it weighed, in the same bottle. Or were weights to be made, which should divide the weight of water decimally, into a thousand parts, the absolute weight would be unimportant, as the number of these parts which were equal to the weight of any other fluid, would be the number which would express its specific gravity. Thus, had I a bottle which would contain a quantity of water, equal in weight to 1000 duck shot, (supposed to be exactly alike in weight,) the number of shot by which the same bulk of any other fluid would be weighed, would also represent its specific gravity.

It happens, that a cubic foot of pure water, weighs exactly 1000 ounces avoirdupoise. This coincidence between its weight, and bulk,

furnishes a ready method for ascertaining the absolute weight of a cubic foot, a cubic inch, or any other given bulk of a substance, the specific gravity of which is known. Let the number 1000, represent the specific gravity, and it also represents the weight of a cubic foot of water; then 13568, which is the specific gravity of mercury, is also the weight in ounces, of a cubic foot, and this divided by 1728, the number of cubic inches in a cubic foot, will give the absolute weight, in ounces, of a cubic inch. All the numbers, in the preceding table, may therefore be considered as expressing the weight of a cubic foot of the substances to which they are attached.

What has already been said, will, to a certain extent, have pointed out the application of specific gravity, to practical uses, and a complete detail cannot be attempted. It is not the ascertaining merely the value and purity of spirits, acids, saline solutions, and infusions, which demands a knowledge of their specific gravities; their fitness for use, in numerous processes, in arts and manufactures, can frequently be best judged of, by the same means. The uncertainty which the artisan supposes to be necessarily incident to a particular operation, results from a difference in some of the circumstances attending it, which may be detected, and with which, it is obviously his interest, to become acquainted; among these circumstances, the strength of his infusions, and of other fluids, hold no unimportant place.

In timber of the same kind, those pieces which have the greatest specific gravity, are superior, both in strength and durability, to those which are lighter. The nature and value of minerals may frequently be determined by the same means; so also may gems be distinguished from imitations of them, and the proportions in which metals have combined in forming alloys, may likewise frequently be thus ascertained.

Clear ideas of many familiar occurrences in the operations of nature, depend upon a knowledge of specific gravity. Why some articles float in water, and others sink in it; why balloons rise, and smoke, and other vapours, ascend in the atmosphere, are questions, the replies to which, must be sought in this branch of science; and when found, they will render these effects as simple and obvious, as the ascent of one scale, when that, at the other end of the beam, is more heavily loaded.

On the difference of the objects embraced by Mechanical Philosophy and by Chemistry. By the EDITOR.

Natural philosophy, taken in its full and proper acceptation, includes both those great divisions of science, which are named at the head of this article; the term Natural Philosophy, is, however, most frequently used as synonymous with Mechanical Philosophy, to the exclusion of Chemistry; this has arisen from the term Natural Philosophy, having been familiarly used, before Chemistry had assumed a place, as a separate branch of science.

The design of the present essay, is to give a distinct and popular

view, of the objects embraced by these departments of knowledge, which, although intimately connected, are also obviously distinguishable from each other. To attain the end proposed, we shall first give a definition of each, and afterwards attempt to render these definitions, clear, by exemplifications. It is only to those who are already acquainted with a science, that its definition, alone, will convey any *definite*, and comprehensive ideas; to other persons, a few well chosen examples, will be of much greater use, and it is for such that we write.

Every change which takes place in the material world, must be accompanied by *motion*; for it is evident, that if all the masses, and all the particles of matter, in the universe, were to retain their respective places, there could be no change, either in the nature, or in the situation, of those bodies of which it is composed. To ascertain the laws of motion, and to account for the changes produced by it, are the objects of both Mechanical Philosophy, and Chemistry, but the kinds of motion of which they take cognizance, differ from each other, and are governed by different laws.

Mechanical Philosophy, is that branch of science which explains the changes in bodies that result from those sensible motions, which take place in *masses* of matter.

Chemistry, is that branch of science which examines into those changes in the *nature* and *composition* of bodies, which result from motion among their *constituent particles*.

By a mechanical force, or power, is intended that by which any portion of matter may be removed from one place to another, but which cannot produce any change in the *nature* of the body. Gravitation, animal strength, and the matter of heat, are among those forces, which are perpetually acting in the operations of nature, and in the machines constructed by man. Cutting, breaking, and grinding, are some of the numerous changes produced by mechanical force: but after they have been carried to the utmost, they effect no change in the *nature* of the substance subjected to their action, although they may alter its shape and size, and remove it from its place. Suppose, for example, a piece of lime to be ground to powder; every particle of this powder, however minute, would still continue to be a particle of lime; yet we know lime to be a compound body; that is, we know that articles of different natures, are combined together to form it; but these articles are so united, that no mechanical force can separate them. The same reasoning would apply to wood, which is composed of several simple ingredients; and in fine to substances, generally.

We have said that the motions which result from mechanical force, take place in *masses* of matter; by the term mass, we mean any sensible portion, however large, or however minute; and even were it supposed to be so small, as not to be a sensible object, yet if it was admitted to consist of two only of the smallest atoms in nature, it would still come under our idea of mass. Thus a mountain of limestone, or a particle of the same rock, so small as to float in the atmosphere in the form of dust, are still bodies of the same nature, differing from

each other in size, alone. The motion in the air by which the dust is wafted from place to place, or that commotion in the interior of the earth by which the mountain may be overthrown, are mechanical forces, and their effects are purely mechanical.

Besides these changes in the size and shape of matter, or in the place, which it occupies, and which we witness in the operations of nature, or see produced by the efforts of art, and are, in either case, effected by forces which we estimate by weight and by velocity, we constantly witness other changes in matter, which it is evident must be governed by different laws, because we find that those laws which guided us in our calculations on mechanical changes, here lend us no aid, when we attempt to apply them; these are changes in the *nature* of a body, and not merely in its form, or place. We frequently see one kind of matter transmuted, as it were, into another, and even sometimes seem to lose its very existence; these are the changes which are denominated chemical, and are the objects of investigation which belong to chemical philosophy.

What we mean by this transmutation, will be evident from a few examples. A bright piece of iron, exposed to the action of air, and of moisture, will gradually lose its metallic lustre; its surface will assume a brown, earthy appearance, which we call rust; by degrees this change will be propagated through the whole substance of the metal, and then it will not only have lost its lustre, but its tenacity will be destroyed, and a slight effort only will be required to reduce it into powder; it is in fact no longer iron, but may as correctly be denominated an earth, as a metal. Motion however must have taken place, or no alteration could have been produced.

From the same ground, nourished by the same water, and acted upon by the same atmosphere, grows a great variety of plants; some nutritious, others poisonous; some sapid and odorous, others tasteless, and without smell, and in fact, notwithstanding their common origin, possessing a contrariety of properties, which might indicate the most entire dissimilarity. It is not in their common origin alone however, that they resemble each other, for notwithstanding the difference of their properties, they are, when subjected to analysis, all found to consist of the same essential ingredients; and when they undergo the vegetable fermentation, and spontaneously decay, they all return again to the state of soil, or manure; which manure, derives no peculiar property from the kind of plants from which it had been obtained. Some substances, we have said, seem to lose their existence; our candles, and the articles used as fuel, justify this remark, in their combustion; and although it may be proved that not a particle of matter is lost, yet our tallow, our coals, and our wood, no longer exist as such, but have changed into *air*, and into *water*, leaving only a small residuum of earthy matter. We might extend our catalogue of examples through all the substances which exist in the world; for if compound, they are liable to decomposition, and if simple, they are capable of uniting with other bodies, and of producing new substances. These changes are all chemical, as indeed, is every change, whether produced naturally, or by art, which cannot be accounted for upon mechanical principles.

Every substance in nature, may, therefore, become an object of investigation, both to the mechanical and the chemical philosopher, and there is but little difficulty in determining to which department of science, any change in matter belongs; or whether a man is engaged in a mechanical or a chemical art. It must be noticed, however, that the mechanical and the chemical powers, in a great number of instances, operate together, and that, consequently, they must both of them be considered, in the explanation of many phenomena.

We will now name a few of those arts which are properly denominated chemical, and we persuade ourselves, that we shall then have said enough to render the distinction which we have been considering, clear to every one.

Brewing, distilling, soap making, colour making, dying, bleaching, calico printing, varnish making, the manufacturing of pottery, glass making, extracting metals from their ores, forming alloys, soldering, plating, gilding on metals, refining, tanning, the making and purifying a vast number of saline bodies, such as common salt, nitre, alum, copperas, blue vitriol, sugar of lead, &c. &c. These are a few of the arts, denominated chemical, because in the practice of them, new substances are produced, differing essentially in their properties from those of the materials employed, and therefore effecting changes not to be explained upon mechanical principles.

We have now entered upon a subject which is no small favourite with us, and to which we have devoted much of our attention. It is probable, therefore, that "The Artisan" will rarely appear without bringing some intelligence relative to chemistry, with a view to render its language, and its facts, accessible to those who have a high interest in becoming familiar with them.

Mr. Marcus Bull has just published a new edition of "Experiments to determine the comparative quantities of heat evolved in the combustion of wood and coal," &c. which appeared in the 5th No. of our first volume. To this new edition are prefixed some valuable preliminary remarks and estimates, which we now present to our readers.

Preliminary Remarks, with observations and estimates; tending to manifest the importance of the subject treated of in the Essay on Fuel, &c.—By Marcus Bull.

From the acknowledged difficulty of obtaining rigid accuracy in researches, having for their object so subtle a principle as caloric; I had anticipated, that objections would probably be made against some part of the apparatus employed in my experiments, tending to invalidate their results.

Notwithstanding the severe examination to which my experiments have been subjected since their publication, the only objection urged against their accuracy, which may be considered as entitled to any

serious attention, is, "that the *surface* of the walls of the *exterior* room, though the air in it be maintained *uniformly at one temperature*, presents for the heat radiated from the surface of the *interior* room, a refrigerating medium of inconstant power; in consequence of the varying temperature of the atmosphere:" or in other words, that, "the *surface* cannot be maintained at the *same temperature* as the *air in contact with it*, during the ordinary changes in the temperature of the atmosphere." This objection I have recently subjected to the most rigid, and delicate test; and that at a period when the difference in the temperature of the atmosphere, and that of the room, was double in amount to any which occurred during my course of experiments; using instruments, similar to those which have been employed, to detect the existence of heat in the rays of the Moon, and with similar results, as to amount, there being no appreciable inconstancy discoverable in the refrigerating medium. These experiments were performed in the presence of a number of scientific gentlemen, who will, if necessary, corroborate the accuracy of this statement.

To place the subject treated of in the following pages, in a more popular, and striking point of view, I have recently ascertained with as much accuracy as was practicable, the quantity and value of the different kinds of fuel, already brought to Philadelphia, to supply its consumption in domestic economy, and for all other purposes, from March, 1826, to March, 1827. The quantity of wood was ascertained from the official returns made to the City Treasurer, by the corders, upon the public landings, and also from the private accounts, and estimates of the corders upon all the other landings in the City and Liberties. The quantity of foreign coal was obtained from the Custom House books, and that of the remaining coals, from the most authentic sources within my reach.

Estimate of Wood and Coals, required for the consumption of Philadelphia, from March, 1826, to March, 1827.

	D. C.	
140,150 cords of Wood, average price - - -	4 50	630,675.
25,545 tons of Lehigh and Schuylkill coal* at -	7 00	178,815.
320,000 bushels of Pine Charcoal - - - -	10	32,000.
95,000 do. of Richmond Coal - - - -	30	28,500.
30,465 do. of Liverpool Coal - - - -	33	10,053.45
		$880,043,45

The population of the City and Liberties of Philadelphia, at the present time, may be estimated at 125,000.† By dividing the whole cost of fuel (880,043.45) by the number of inhabitants (125,000) we obtain $7.04 as the average cost of fuel for each inhabitant, supposing the consumption to be equal; but as this is not the case, it is not

* The whole quantity of coal sent from these mines to Philadelphia in 1826, was 47,545 tons, of which 22,000 tons were sent abroad.

† The population of the city and liberties, by the census for 1810, was 92,247, and for 1820, 108,116.

my intention to apply this calculation individually, but to large portions of the community. Supposing each article to be sold at its true comparative value, we may infer, from the foregoing calculation, that the quantity of fuel required in Philadelphia, for every purpose, would be nearly supplied by 125,000 tons of Lehigh or Schuylkill coal, or one ton for each inhabitant.* If we look prospectively to the early period, when these coals may be expected to be furnished at $5 per ton, their substitution for other kinds of fuel, in all cases where it is practicable, will become a matter of general interest.

The climate of Philadelphia is, perhaps, a fair average of that portion of the Atlantic States, from Maine to Georgia. If we suppose that its consumption and prices for fuel, are also fair averages, for the inhabitants residing in those States, near tide water, we may extend our calculations with some degree of accuracy, beyond our own fire-sides.

From the Census of the United States for 1820, we find that the whole population was 9,638,226, and that the Atlantic States from Maine to Georgia, both inclusive, contained 7,151,959, of which number about 2,500,000 resided within ten miles of tide water. The same district of country may now be supposed to contain 3,000,000 of inhabitants,† which, multiplied by the cost of fuel for each inhabitant of Philadelphia, (say 7 dollars,) we obtain 21 millions of dollars, as the cost of fuel for these inhabitants, for one year. This portion of the United States, will, it is presumed, at no very distant period of time, be principally supplied with fuel from the coal mines of Pennsylvania, and at an estimate of one half the required quantity, will consume 1,500,000 tons, annually: which, at $5, will amount to $7,500,000.

If we suppose the United States to have increased 20 per cent. since 1820, they contain at the present time 11,565,871 inhabitants, and if we estimate the cost of fuel for the remaining 8,565,871, at $3 50 for each person, these numbers being multiplied by each other, we obtain $29,980,548, which being added to the 21,000,000 as the cost for the 3 millions before stated, we have an aggregate cost of $50,980,548 for the fuel consumed in the United States, for all purposes, during one year.

The following statement of the consumption of fuel in London, and its environs, for one year, is made for the purpose of comparing it with the consumption of Philadelphia, in the proportion of their respective population.

From an official account, it appears, that there were imported into

* These coals, as brought to market, are probably of the same value in equal weights, although a slight variation was found in my results, from the specimens experimented upon.

† I find by calculation from the enumerations in 1790, 1800, 1810, and 1820, that the rate of increase between those periods, was as follows. From 1790 to 1800, 35 per cent., 1800 to 1810, 36.4 per cent., 1810 to 1820, 33.1 per cent.; at which latter rate from 1820 to 1826 inclusive, gives 19.8 per cent., say 20 per cent., or an increase of 500,000 inhabitants in 2,500,000, making an aggregate of 3,000,000 as above stated.

London during the year 1824, 1,505,021 chaldrons of coal, to supply the consumption of London and its environs, which, at that time, were estimated to contain 1,500,000 inhabitants. This quantity gives very nearly one chaldron, or 36 bushels, of Newcastle coals (average cost 48 shillings, or $10.67) for each person; and the quantity of heat evolved from the combustion of which, is only equal to that from 20 bushels of Lehigh coal. Now we find that in Philadelphia about one ton, or 28 bushels of Lehigh coal, may be estimated to be required for each person; the proportion therefore between the two places for each inhabitant, in quantity, is as 20 to 28, and in cost, as 10.67 to 7.04. The discrepance in the quantity, may be attributed to the milder climate of London during the winter season, and to the greater frugality of its inhabitants, in the use of fuel, both in the arts, and in domestic economy.

Philadelphia, January 1, 1827.

The following notice is extracted from Professor Silliman's Journal, Vol. xi. No. 1. p. 98.

I have been just favoured with a copy of a Memoir, by Mr. Marcus Bull, read before the American Philosophical Society of Philadelphia, April 7, 1826—entitled:

"*Experiments to determine the comparative quantities of Heat, evolved in the combustion of the principal varieties of wood and coal, used in the United States for Fuel; and also to determine the comparative quantities of Heat lost by the ordinary apparatus made use of for their combustion.*"

This memoir is the result of a long course of experiments, evidently conducted with great care and skill. It is replete with interesting information, and is to be regarded as one of the most important contributions of science to the arts and to domestic economy, which has been made for a long time in this country. It is worthy of being carefully studied, both by scientific and practical men, and for the sake of the latter class, it might be well if an analysis of this elaborate and detailed paper, presenting, in a lucid and concise form, the practical important results which have been obtained by Mr. Bull—were prepared for extensive circulation.

FROM THE GLASGOW MECHANICS' MAGAZINE.

ESSAYS ON MATHEMATICS.

By the late Mr. John Cross, *Teacher of Mathematics, Glasgow.*

No. I.

The word mathematics originally signified discipline or learning, (science;) but it is now appropriated to that science which teaches the comparison and mensuration of magnitude. It has also been termed the science of quantity, and in this view, the objects to which

it may be applied are equally numerous and various as the objects of our senses; for whatever is the object of our senses, is capable of being considered, either with respect to its number, its extension, or its quantity.

Mathematics are divided into *pure* and *mixed*.

Pure mathematics considers magnitudes generally, simply, and abstractedly, without any relation to matter or sensible objects.—Under this class are comprehended,

1, Arithmetic, or the art of numerical computation;

2, Geometry, which teaches us to measure extension;

3, Analysis, or the comparison and calculation of magnitudes in general;

4, Mixed geometry, or the combination of geometry with analysis.

Mixed mathematics borrow from physics, that is natural philosophy, one or more incontestable experiments, and then, by a demonstrative chain of reasoning, they deduce, from established principles, conclusions as certain as those of pure mathematics.—Under this division are comprehended,

1, Mechanics, the science which treats of the effect of moving powers, or forces, and the laws of motion;

2, Hydrodynamics, which explains the motion of fluids, and the laws of their action;

3, Astronomy, which considers the revolutions and various phe nomena of the sun, moon, and other heavenly bodies;

4, Optics, the science of vision, including the properties of light and colours;

5, Acoustics, the theory of sounds.

Mathematics have also been divided into speculative and practical; a division which applies both to the pure and mixed.

Speculative mathematics inquires after knowledge which it is proposed to attain, and simply contemplates the truth or falsehood of what is asserted.

Practical mathematics is the application of the speculative, and shows how to perform something useful or advantageous to mankind.

It is not possible to fix the origin of mathematics with precision, though we are able to affirm that it goes back to the remotest ages. Josephus asserts that they were studied before the flood; that the sons of Seth were observers of the heavens; that they built two pillars, the one of brick, the other of stone, to commemorate their discoveries, and that Abraham taught these sciences to the Egyptians, who, however, there is reason to suppose, were acquainted with the science previous to the period of the Patriarch's sojournment among them. The most certain and best established opinion is, that the mathematics began to acquire a certain solidity almost at the same period among the Chaldeans and Egyptians, the two most ancient people known in history.

The magi, or priests of Egypt, directed by the laws of their insti tution to study and collect the secrets of nature, were become the depositaries and dispensers of all human knowledge; but they have been blamed with involving their discoveries in mystery. It is said

that Thales travelled into Egypt about 600 years before Christ, and brought the mathematical sciences into Greece; and, whether this be true or not, it is only from this time that we have any certain accounts of them.

With the mathematics of the ancients we are acquainted only through the writings of the Greeks, and we do not possess the necessary documents to estimate the instruction which these derived from their intercourse with the more eastern nations. We know, however, that as soon as the mathematics took root in Greece, their progress was rapid, and the Grecians became, in some measure, the preceptors of all nations. The elementary books collected and arranged by Euclid, have been translated into all languages, and have continued for more than 2000 years to be exclusively taught in every mathematical school—a certain proof of their excellence. The conics of Apollonius hold an equal rank in what has been called the higher geometry. Many other mathematicians laboured in the same field, but the most exalted rank in this legion of honour has been assigned, both by reason and fable, to the sublime genius of Archimedes.

In the accurate sciences which require cool attention, silence, and profound meditation, the Romans never surpassed mediocrity. Useless as the means of attaining the first offices of the state, they were the occupation of a few obscure individuals, remote from the agitation of public affairs. The Roman mathematicians were little more than translators or commentators of Archimedes, Apollonius, &c.

On the death of Theodosius, and the division of the empire, the western part was long ravaged, and at length subjugated by barbarians, and soon sunk into profound ignorance; while the eastern schools were wholly employed in theological disputes. The accurate sciences had taken refuge in the Alexandrian museum, (almost the only refuge they had left them,) which was founded by Ptolemy Philadelphus, about 320 years before Christ. Here the mathematics flourished near ten centuries. But of this asylum they were deprived about the middle of the seventh century, when the Arabs, conducted by the successors of Mohammed, spread carnage and devastation through the east, the museum and library of Alexandria were destroyed.

However, though the chain of mathematical discovery was broken by this fatal catastrophe, a few links remained, which this nation of destroyers, softened by the charms of peace, strove to collect and unite afresh. In less than a century we find the Arabs cultivating astronomy, and their taste for a particular science gradually extended to all the branches of knowledge. For the space of seven hundred years, the mathematics flourished in the extensive dominions of the caliphs; by the Moors they were carried into Spain, and spread over the rest of Europe. And the Arabs rendered essential service by their translations of the works of the ancient Greeks, with some of which we are acquainted, only through the medium of the Arabic version.

The conquests of the Turks brought back ignorance and barbarism, on the delightful countries which the Arabs inhabited; and extin-

guished the lamp of science which had long glimmered with fading lustre in the dissolute and desolated provinces of the eastern empire. At the taking of Constantinople by Mohammed II. a persecution arose against artists and men of learning, by which many of them were destroyed; but some escaped, and carried with them the remains of the mathematical sciences into Italy, France, Germany, and England, countries in which a taste for literature had already begun to take root.

From this period, all the branches of the mathematics made rapid progress. The improvements of the moderns have put us in possession of an infinite number of problems, inaccessible to the ancient geometricians. The ancients have given us nearly the whole of what has been termed pure or speculative geometry, few additions have been made to the fundamentals of the science—most of the modern works on plane geometry, or the conic sections, are compilations from theirs; but the moderns have improved arithmetic. The ancients knew little, if any thing of algebra, and we claim the sublime invention of fluxions as our own. We have applied the mathematics to the improvement of practical arts and sciences, as mechanics, projectiles, gunnery, astronomy, and optics, far more extensively than they; and they were ignorant of the combination of analysis and geometry which we employ.

But let it not be supposed that the moderns have surpassed the ancients in genius. It is probable that the discoveries which they made, required, in the infancy of science, intellectual exertions as great as any modern improvement. The most important improvements in science have always been preceded by gradual advances. The discovery which astonishes when it is announced, can often be traced through many previous steps which all contribute to bring it to light; and the wonder that it should not have been sooner made, is often greater than the surprise which it occasions.

We are possessed of instruments, which are equally just, which arrive, by a shorter process, at the end proposed; but we are inferior to the ancients in pure geometry. If Archimedes were to return to this earth, with all the wonderful attainments he possessed, he would be obliged to subject himself to a long course of study before he could place himself on a level with Newton; yet Newton lamented that he had too much neglected the strict geometrical reasonings of the Syracusan sage.

On the coral reefs and islands of Australasia and Polynesia.

Throughout the whole range of the Polynesian and Australasian Islands, there is scarcely a league of sea unoccupied by a coral reef, or a coral island; the former springing up to the surface of the water, perpendicularly from the fathomless bottom, "deeper than did ever plummet sound," and the latter in various stages, from the low and naked rock, with the water rippling over it, to an uninterrupted forest

of tall trees. "I have seen," says Dalrymple, in his Inquiry into the Formation of Islands, "the coral banks in all their stages; some in deep water; others with a few rocks appearing above the surface; some just formed into islands, without the least appearance of vegetation; others with a few weeds on the highest part; and lastly, such as are covered with large timber, with a bottomless sea, at a pistol-shot distance." In fact, as soon as the edge of the reef is high enough to lay hold of the floating sea-wreck, or for a bird to perch upon, the island may be said to commence. The dung of birds, feathers, wreck of all kinds, cocoa-nuts floating with the young plant out of the shell, are the first rudiments of the new island. With islands thus formed, and others in the several stages of their progressive creation, Torres' Strait is nearly choked up; and Captain Flinders mentions one island in it covered with the *Casuarina*, and a variety of other trees and shrubs, which give food to paroquets, pigeons, and other birds, to whose ancestors, it is probable, the island was originally indebted for this vegetation. The time will come—it may be ten thousand, or ten millions of years, but come it must—when New Holland, and New Guinea, and all the little groups of islets, and reefs, to the north, and north-west of them, will either be united into one great continent, or be separated only with deep channels, in which the strength and velocity of the tide may obstruct the silent and unobserved agency of these insignificant, but most efficacious labourers.

A barrier reef of coral runs along the whole of the eastern coast of New Holland, "among which," says Captain Flinders, "we sought fourteen days, and sailed more than 500 miles, before a passage could be found through them out to sea." Captain Flinders paid some attention to the structure of these reefs, on one of which he suffered shipwreck. Having landed on one of these new creations, he says, "we had wheat-sheaves, mushrooms, stag's horns, cabbage leaves, and a variety of other forms, glowing under water, with vivid tints of every shade betwixt green, purple, brown and white." "It seems to me," he adds, "that when the animalcules, which form the coral at the bottom of the ocean, cease to live, their structures adhere to each other, by virtue, either of the glutinous remains within, or of some property in salt water; and the interstices being gradually filled up with sand and broken pieces of coral washed by the sea, which also adhere, a mass of rock is at length formed. Future races of these animalcules erect their habitations upon the rising bank, and die in their turn, to increase, but principally to elevate this monument of their wonderful labours." He says that they not only work perpendicularly, but that this barrier wall is the highest part, and generally exposed to the open sea, and that the infant colonies find shelter within it. A bank is thus gradually formed, which is not long in being visited by sea-birds; salt-plants take root upon it, and a soil begins to be formed; a cocoa-nut, or the drupe of a pandanus, is thrown on shore: land-birds visit it, and deposit the seeds of shrubs and trees; every high tide and gale of wind add somethiug to the bank; the form of an island is gradually assumed, and last of all, comes man to take possession.

If we should imagine one of these immense coral reefs to be lifted up by a sub-marine volcano, and converted into an insular, or continental ridge of hills, such a ridge would exhibit most of the phenomena that are met with in hills of lime-stone.—*Glasgow Mech. Mag.*

Hints to Paviers. By Colonel F. Maceroni.

In our 137th number, we gave a brief account of a plan, by Colonel Maceroni, for improving the pavement of London, (as well as other cities,) by means of pressure applied in three different stages of the work; first, to harden the ground previously to laying the stones; second, to fix and depress them when laid; thirdly, to equalize and perfect a pavement after it has been some time in use, by applying the pressure only on the protuberant parts. We have since been favoured, by Col. M., with a copy of the pamphlet, from which that account was taken; and as only a few copies of the same were printed, for private distribution, we feel happy in having obtained the author's permission to reprint, for the use of our readers, all that part of it which was not included in our former extract. It will be found to contain much useful information, and sensible remark.

[*Editor London Mech. Mag.*

"However true it may be, that an observant traveller cannot fail of being struck with admiration at the excellence of the turnpike and other roads throughout this country, he must, at the same time, be very much surprised at the badness of the *carriage pavement*, even of the principal streets of this astonishing metropolis. It is difficult for him to understand how, in a country where every mechanical art is best understood and actually applied to the most useful purposes—where ingenuity, guided by science, is ever on the research, and ever sure to be rewarded for each fresh improvement—how, in the very capital of such a country, the carriage pavement should be, perhaps, worse than that of any other metropolis in Europe? It is, to be sure, justly boasted, that this city enjoys the advantage of commodious and matchless foot-paths, and that the existence and goodness of such foot-paths is, in one point of view, of more general convenience and personal comfort, than that of a perfectly level and easy carriage pavement, inasmuch as the safety and convenience of the thousands who walk,* should be preferred to that of the dozens who ride

* It appears somewhat surprising and anomalous, that in this most aristocratic of all countries, so much attention should have been bestowed ou the construction of footpaths. In monarchical France, no such accommodation was ever thought necessary for the "*canaille,*" who, consequently, are left to scramble out their way in the mud, amongst the carriages, and under the hoofs of "their excellencies'" horses.

Even at Bagdad, Aleppo, and Damascus, there are commodious footpaths to a considerable distance beyond the suburbs!

in their carriages. But, in a city like this, teeming with life and activity, throughout which so many thousand public conveyances perpetually travel at so rapid a rate, the state of the *carriage pavement* must surely be a matter of very great importance.

Previously to pointing out what I conceive to be the most advantageous method of improving the carriage pavement of London, I think it will be expedient to offer a few observations on the nature and construction of such pavements on the continent, as are most remarkable for their excellence and durability.

The ancient Roman paved roads, such as the Via Appia, the Sabina, the Flaminian, Emilian, &c. &c., first claim our attention. Of these, there are still tracts of many miles in perfect repair in southern Italy, especially in the neighbourhood of Rome. A good foundation of gravel, broken limestone, or of basalt, was sometimes applied, where the nature of the soil required it. It is unnecessary to mention the causeways of solid masonry over which they were at times carried, as such causeways, in certain situations, were as indispensable as they would be at the present day under the same circumstances of locality.

The stones composing the pavement of these roads are uniformly of basalt,* of a polyangular shape, containing, on an average, about four or five feet surface, and about twelve or fourteen inches in depth or thickness. They are generally more or less slightly pyramidical, and placed with the base or broadest surface uppermost.† It is by no means in every instance, as is asserted, that these stones are laid in a bed of mortar; in many situations I have found it otherwise.‡ Neither are their edges chipped with any great nicety; the juxta-position is, however, well contrived, and indeed very remarkable; for although they vary *ad infinitum* in shape, angles, and more or less in size, they are fixed together as though each had been expressly cut for its situation.

It would appear, that in many places large tracts of these roads have been intentionally destroyed, either for the sake of the materials, or for the purposes of war and devastation; other portions have, in the lapse of ages, disappeared with the gradual changes to which the surface of this earth is subject, especially in inhabited districts,

* The preference for basalt was so decided, that where the roads, for instance, traverse the Appenines, composed of marble and the hardest limestone, basalt has still been used, though it must have been conveyed thither at a great expense. In some instances, however, I have observed a single line of large marble or limestone blocks applied as an edging or "curb" to the basalt.

I am inclined to believe, that this exclusive use of basalt is attributable to its being, although harder, less slippery than marble or limestone. I have particularly remarked in the town of Caserta, where some of the streets are paved with limestone, and the rest with basalt, that the former alone are most inconveniently and dangerously slippery, although both kinds of stone are cut and laid in a similar manner.

† I should, however, recommend the upper and lower surfaces to be equal.

‡ In most cases no more mortar was used than was sufficient to fill up the interstices, which, from the shape of the stones, were wider below than at the surface.

when barbarism rapidly succeeds civilization, or civilization, barbarism. Such portions, however, as have been left to contend with the mere wear and use for which they were constructed, some two thousand years ago, are in as good order and preservation as ever.

The pavements, most similar in construction and solidity to the ancient Roman, are the modern Neapolitan. The stones of these are also of basalt; but, in lieu of being polyangular, they are rectangular quadrangles, mostly squares, generally of about four feet surface, and six inches in thickness. The sides are very accurately wrought, as well as the surface, which is left as rough as is consistent with a good level. These stones are laid in a thick bed of the best Puzzolana mortar, and always so arranged that the lines of junction are never parallel with the line of road, but cross it diagonally. This pavement excels in evenness and level; is very permanent, but expensive, and liable to become dangerously smooth, which renders it necessary, from time to time, to cut grooves on its surface. The city of Naples being admirably provided with sewers and sub-ways of the most solid construction, the necessity for disturbing the pavement very seldom occurs, so that the expense, though great, is pretty much confined to the first laying.

The pavement of modern Rome is also of basalt. The stones are parallelograms of about two cubes in length; and on being set up endways, they present about ten inches square surface. Although they are accurately cut, and equal in size, they are simply fashioned by a few skilful blows of the hammer. More mortar is used in the construction of these pavements than even in the Neapolitan. I have observed the bed of the best Puzzolana mortar, on which they are laid, to be above a foot thick.* Rome being provided with the most extensive and complete sewers and sub-ways of any city in the world, its pavement, or, as it may be called, this horizontal wall, has likewise very seldom any occasion to be disturbed.†

I believe it will be found that the level of most cities has a tendency to a gradual rise; as more materials are introduced into them than are ever taken out again. The numerous sackings, burnings, and subversions endured by Rome in the barbarous wars of the lower empire, and the "good old times" that followed, have produced a considerable rise in its level. This has necessarily been greater in the lower parts between the celebrated seven hills, whose relative elevations have diminished proportionately. Thus the famed Tar-

* When the Roman or Neapolitan pavement is fresh laid, care is taken to cover it a foot deep with earth or rubbish, to protect the mortar, until it is set, from the jars of the carriages.

† At present there are in Rome but few streets which exhibit the ancient polyangular pavement. In most parts of the city it lays at the depth of from eight to twelve feet beneath the present surface. The accumulation over the whole extent of the Forum Trajanum, which was cleared away by the French in 1813, was, on an average, about twelve feet. That over the Forum Romanum, situated between the Mons Capitolanus and Mons Aventinum, was still greater.

peian rock, or precipice, on the south side of the capitol, has by the process of subtraction from the top, and addition to the bottom, during more than two thousand years, been reduced to less than forty feet in height.

[TO BE CONTINUED.]

FURTHER HINTS TO PAVIERS.

The following is the extract from Colonel Macirone's pamphlet, published in the Mechanics' Magazine, and to which reference is made at the beginning of the preceding article.

My expedient is pressure, which may be applied in three different stages of the work; first, to harden the ground previously to laying the stones; secondly, to fix and depress them when laid; thirdly, to equalize and perfect a pavement after it has been some time in use, by applying the pressure only on the protuberant parts.

The machine I propose for the above purpose is similar to a pile-driver of the lesser kind; the weight being drawn up by a rope passing over a single pulley wheel at the top of the slide shafts, and terminating on the other side, in a cluster of smaller ropes or cords, one for each of the six, eight, or ten men employed to work the machine. The weight, or "monkey," as I believe it is called, is raised by simultaneous hauls of the men, and let fall again by similar alternating movements of relaxation. For my purpose, the weight should be of wood, more or less conical, with a flat circular base of about three feet diameter. A solid block of oak, well bound and shod with wrought iron, and weighing about 5 cwt. would produce sufficient force with very little raising, consequently with much rapidity, and be at the same time perfectly manageable. The perpendicular slide shaft and stays, together with the weight, that is to say, the whole of this simple machine, is to be fixed upon a quadrangular frame of about eight feet by five; and to this frame I would attach four or six pivot or castor wheels, of about a foot diameter, by which it might be moved with the greatest ease in every possible direction. If the men who work the weight are made to stand upon the frame itself, it may he worked uninterruptedly, while it is regularly drawn over the pavement, faster or slower, repeating or not repeating the blow on the same spot, according to the intention and discretion of the superintendent.

It surely must be allowed, that the present method of simply digging up the ground to a considerable depth with a pickaxe, without any subsequent hardening, can but furnish the stones with a foundation of very unequal resistance. It is true, that, after laying them in this soft bed, they are slightly compressed with a hand rammer; but it is obvious, that unless this compression be made equal to that which the stones will afterwards have to endure from carts, &c. the surface of the pavement must speedily give way, and become the counterpart

of the unequally dense substratum. Even were the subjacent earth quite uniform in its density, or rather, I should say, in its softness, it is absurd to expect the pavement can preserve its level, when that density is so far from being sufficient to resist the maximum of pressure it is destined subsequently to endure. Were this subsequent pressure equally distributed, and applied to every stone, we might then expect the whole surface to sink together; but as this can never be the case, inequality of pressure will speedily produce inequalities of the surface, which must increase in a rapid geometrical ratio. To establish a permanently level pavement with the materials we are speaking of, I do not say that the subjacent earth must be of a perfectly homogeneous density; it is sufficient that it be so compressed, either before or after laying the stones, or both before and after, that its parts of minimum density be able to resist the maximum of the pressure it will be subsequently liable to. In laying a new pavement, I should advise, first, moderately to compress the earth, and afterwards repeat the ramming on the stones; by which division of the operation a degree of density will be obtained, with the application of much less power than would be required to produce the same by only one application on the surface of the pavement. If at this period the proper quantum of compression has been given, there is no fear of any inequalities being formed by the action of the heaviest vehicles; but I should not think it requisite to give a similar density to the pavement in every street, there being many through which a vehicle heavier than a coach is seldom, if ever, known to pass.

In cases where a street has been already paved in the usual way, and when, as is usual in a few days, it has begun to assume its wonted picturesque unevenness of surface, it may be rendered perfectly and permanently level, without the expense of taking up the stones, by the careful application of the machine I recommend. But the operation must not be too long delayed, for inequalities once formed, must necessarily increase with accelerated rapidity, inasmuch as the wheels continue to fall into the depressions with a momentum, which progressively increases with the increase of the depressions. An early obliteration of the protuberances will put a stop to the evil, and a permanent density be established.

The exact state of the surface of the pavement is rendered remarkably evident and definable when water is thrown upon it; which I have had particular occasion to remark, when it has been applied abundantly to lay the dust. This I would make auxiliary to the after-compressing operation I am now speaking of. The water-throwers should precede the machine, and certain men, with a good and careful eye, might mark the projecting stones with chalk, as a further guide to the action of the compressor. It is also probable that the water would, more or less, diminish the friction of the stones against each other, and facilitate their descent. I have frequently observed, that nearly one half of Piccadilly might be levelled in this manner, without the necessity of taking up a stone, except in a very few places, where extraordinary depressions have been formed. I

do not, however, wish to establish the utility of the method I propose, on the merits of this second-hand application of it, but mainly upon its application under and upon the stones, at the time of laying them. Nothing else will produce a level and permanent pavement with the materials at present in use, and consequently without increase of expense. With regard to the improvement of these materials, it is certain that the more exactly the stones are cut, the better; but this I apprehend must be regulated by the prescribed latitude of expense: it would be well to take off their convexity, by a few good chips from the top or crown of the stones that are much worn. But let them be wrought with the most mathematical nicety, it will avail nothing in the end, if they are laid according to the soft, uncompressed method of the London paviers. If we would have an even pavement, we must either have recourse to the deep beds of cement, or the huge stones I have described in the beginning of this article, with all their expensiveness and other inconveniences; or we must apply to the method and materials already in use, the only process which will remedy their evident defects, and produce the wished-for result. As to the earth in which the stones are laid, I should prefer a mixture of broken gravel, dry rubbish, and a little chalk; but this arrangement also, must depend on the expense. The quantity of oxide and carburet of iron which forms under the pavement, produces a strong tendency in the subjacent mass to indurate and agglomerate, which would be very greatly accelerated by the pressure I recommend.

It now only remains for me to refer to the principal, or only, objection which I can anticipate, might be made to the use of my machine; which is, the supposed injury it might occasion to the gas and water pipes. It will be very easy to prove in half an hour, by experiment, that no such injury can occur. Cast iron pipes, at the depth of two feet, would not sustain any injury from the utmost efforts of the engine, especially if any care had been taken to lay the finer portion of the earth or gravel in immediate contact with them. But this precaution, I affirm, will be by no means necessary, if the pipes are from two to three feet from the surface, which surely is not an unreasonable depth.

On the Management of the Bellows, Tuyeres, and Fuel, in Smiths' Forges.—By Thomas Gill, Esq.

We have already treated at some length on these important subjects, still, however, much remains to be said thereon, and we shall accordingly continue to add, from time to time, such additional facts as may come to our knowledge.

We mentioned (see Vol. II. page 59) that Mr. Duncan Campbell uses a wider aperture to his bellows and tuyere than is usual, and that his tuyere is an inch in diameter, and widens towards the forge fire; to this we may add that he has fitted other tubes to his tuyere, by which he can occasionally contract its bore, according to the kind

of work he is employed upon; thus, for small work, as nails for instance, he contracts it to a bore of only half an inch, and has also an additional tube of three quarters of an inch in diameter.

He was much perplexed lately, at being unable to excite his fire with his usual readiness, in order to heat an article of some bulk, and long laboured at his bellows with all his might, but in vain; at last he recollected, that in making some nails he had contracted the tuyere to half an inch only, and accordingly he removed the contracting tube, and widened it to an inch, when he readily brought his heat up.

Mr. E. Hazard informed us lately, that in employing the *Anthracite*, or stone-coal, in the United States, as fuel in smiths' forges, it is necessary to increase the bore of their tuyeres to an inch and a quarter in diameter, when there is no difficulty in using it. This information may prove the means of enabling us to bring *the immense beds of anthracite in South Wales* more generally into use.

Mr. W. Mason confirms the superior efficacy of *wide bellows-pipes and tuyeres*, in heating large masses of iron or steel in forge-fires. He has used them so large as *an inch and a half in diameter*, and with the most beneficial effect, in quickly bringing his axle-trees, &c. to a welding heat all through, without, as usual, burning away their exterior surfaces. Neither is the *striker* who blows the bellows so much exhausted, by the great labour of working them to bring up his heats, as to nearly unfit him for exerting his strength with the hammer, as is commonly the case; on the contrary, the bellows with wide nozzles and tuyeres, are worked with much greater ease, than those with the usual narrower ones. There will indeed, be some difference found, in *the heats being brought up much quicker with the wide tuyeres;* but that, surely, can be no objection, either to an industrious workman or his employer.

Mr. Mason informed us, that he was much pleased to witness lately, the superior management of his fire, by *a twisted gun-barrel forger*. He spread a considerable quantity of fresh *Staffordshire coal* over the whole extent of his hearth, having previously broken it into small lumps; and so contrived it, that he always reduced it to the state of *coke* or *cinder*, before it formed his forge-fire; thus producing its best effects, in heating the barrels to a welding heat. He was continually bringing fresh coal gradually forwards towards the fire, so as, by degrees, to consume the bituminous parts of it, and finally convert it to the state of coke.

In the use of *sea-coal*, or that which possesses a *caking* or *binding property*, owing to the excess of bitumen it contains, and which admirably fits it to form *hollow-fires*, Mr. Mason states, that it is absolutely necessary to feed those hollow-fires with such coal, previously reduced to the state of coke or cinder; as, otherwise, great injury is produced in the fire, from the sulphur and bitumen contained in the coal.

The following accident occurred, owing to the want of attention, or of the requisite knowledge, in a smith at Cambridge, who was lately repairing an axle-tree. Mr. Mason, to whom it belonged, had not

turned his back, to speak to another person, above a minute or two, before he heard a violent hissing noise, and found that the smith had nearly burnt the axle in two.

No doubt the bellows-pipe, and tuyere, of his forge, were both of them too small; or else this accident would hardly have occurred. The blast being always *much sharper* from such causes, and acting *partially* upon the bodies to be heated by it. [*Tech. Repos.*

On preserving Turnips and their tops, as winter food for Sheep and Cattle. By the Rev. T. C. Munnings. *Extracted from the Transactions of the Society for the encouragement of Arts, Manufactures, and Commerce.*

It has long been considered, by those who are engaged in farming, as a material desideratum, to defend and secure turnips from that host of foes with which they have to contend, and more particularly to preserve them from the injurious effects of frost, in order to receive the full benefit of them as winter and spring food for sheep and oxen.

Dr. Martyn indeed mentions some methods which have been pursued for the attainment of such an end; but as none of them have been admitted into very extensive practice, it may be presumed that they have been abandoned, on account of the difficulty of executing the prescribed work; on account of the expense attending it; or on account of its being inefficacious.

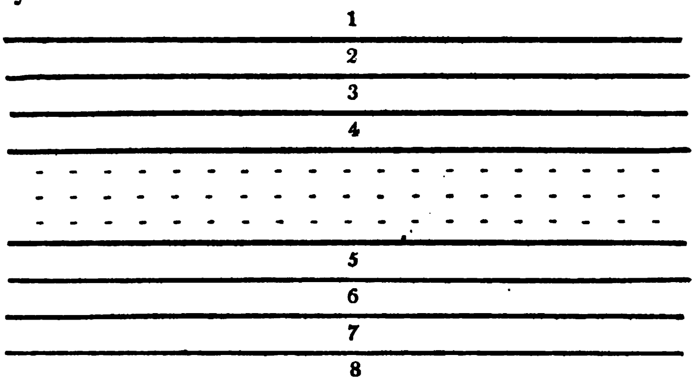
It has *twice* been my lot to be most flatteringly noticed by the society, for my successful efforts in the cultivation, and for the protection and preservation of turnips during the winter months; it is my earnest wish to give as succinct, but at the same time as clear an account as I can of my experiments for such purposes.

It must be understood, in the first place, that my turnips are *drilled* at the distance of alternate furrows, that my ridges are set out precisely the width of fifteen feet, and that each ridge contains exactly eight rows of turnips. This being the case, I have at various times within the last four years made use of the following methods of *preserving turnips during winter months.*

The first and most simple which I shall mention, was only with a narrow-set double-breasted plough, drawn by one horse, to plough between the rows, and throw earth each way upon the apples of the growing turnips. The advantages of this mode were, a partial ploughing of the land in the early part of the winter, and a preservation (almost perfect) of the turnips for spring consumption.

The second mode which I next invented (I say next invented, because the first mode differs from the Northumberland practice only in the circumstances of my turnips growing upon a flat surface, instead of the tops of two furrow work, and therefore more easily defended with a plough) was first executed by casting away the alternate rows for autumnal consumption; thus leaving rows somewhat

more than a yard asunder, and then with a one-horse single-breasted plough moulding up the same; thus giving to the land the appearance of what is called Tops and Balks; each top embracing and defending a row of turnips, and the balks being in the lines from whence the turnips were removed. I look upon the advantages of this plan derived from such seasonable ploughing to be similar to those in the first-mentioned mode; but as the turnips are covered with a greater body of earth, the preservation of them is so much the more perfect, because the frost must be more intense before it affects them, and, in case of a thaw, is discharged from them more gradually. The third mode may easily be conceived, by the following supposition. Let the lines 1, 2, 3, &c. represent the eight rows of turnips growing upon a ridge, eight being the most convenient number of rows for the easy execution of the work.



Conceive half of these lines to be upon one ridge, and half upon another; in that case, there will be a furrow between 4 and 5. This furrow is to be opened with a double-breasted plough (drawn by one horse), which will raise mould for the protection of what I will call the insides of the two rows 4 and 5; the rows 1, 2, 3 were then to be pulled by one man or woman, and put into the opened furrow between 4 and 5, with their tops inclined towards 4. In the same manner the rows 6, 7, 8 are to be pulled by another man or woman, and put into the same furrow, with their tops inclined towards 5. Two or three furrows are then to be ploughed, with a one-horse foot plough, to the outsides of the rows 4 and 5, and some mould from the third furrow so ploughed, shovelled into the apples, and part of the tops of the collected rows; (of this shovelling I think, from what I have done, that a good labourer will finish two acres in three days) and the ploughing may be then carried on so as to give the land almost a complete earth.

Of this plan the advantages are so evident as scarcely to need explanation. Those derived from the ploughing are here nearly complete, as three parts out of four of the growing crops are removed from their native beds in the very beginning of winter (say sometime in Novem-

ber); and, deposited in trenches, continue for a considerable time in a state of suspended vegetation. The surface which is then turned up will be ameliorated by the frosts between that time and the early part of the spring; when, if the weather permit, the land may be ploughed *back again from the trenches*, and reap the advantages of a second earth in preparation for the following crop of corn. The turnips may, after this second-ploughing, be most easily scattered about the field, which may be enriched by the feeding manure; or they may be carted off with so little injury to the land as to leave it in a very proper state for immediate sowing. But the peculiar advantage of this plan, and a most material one it is, consists in the wonderful facility with which turnips so defended may be got at, when those unprotected, or protected but in single rows, are fast bound by the frost. Here, as the whole of eight rows are collected into a small space, if the frost be extremely severe, the land will be kept open by the tops of four rows of turnips *united* in the lines 4 and 5, and being easily removed from the top of them, the whole body so collected will be exposed in a *sound* and *unfrozen* state. I conceive that it would be an *improvement* of this plan to use a little straw or haum for the purpose of covering the turnips before the mould is shovelled over them, as it would increase the facility of uncovering them, not only during the severity of the winter, but upon the dissolution of frost, and would keep them cleaner, and render them easier of access.

Perfectly efficacious as this mode was experimentally proved to be, it failed of giving general satisfaction to the *farmers*, who, objecting to the shovelling part of it, wished to have the whole of what was done confined to the powers of the plough. The last method, therefore, which I have made use of, was practically executed, thus. The eight rows of turnips growing as described in the last mentioned mode, were the whole of them pulled, and put as *upright* and *close as possible* into the trench opened between two ridges, and then lengthening the spindle of a wheel plough, or the pulling-tree of a foot plough, so as to enable the off-horse to walk clear and wide of the turnips, they were buried almost entirely by means of the plough, and the whole of the land was clean-ploughed, at the time of protecting them. In the beginning of the month of March 1803, it was satisfactorily evident that the turnips were completely preserved, and that the land had received the entire benefit of a winter's earth.

As to the advantages derived from ploughing, I regard this plan as very little, if at all superior to the last mentioned; and however the novelty of it, the facility of its execution, or the extreme neatness of its appearance when executed, may powerfully recommend it, I do not myself prefer it to the immediate foregoing mode, in which the casual advantages of shovelling *may* be very considerable, and I really think will always be sufficient to defray the expenses of that peculiar part of the operation.

A description of the Water Wheel and Forcing Pump, used at the Philadelphia Water Works, constructed under the direction of Frederick Graff, *Esq.*

[With a plate.]

We have in preparation, a short history of the origin, progress, and present state, of the water-works, at Fair Mount, which will appear in an early number of the Journal. These works have been admired by all who have seen them, as monuments both of the taste and skill, of the persons concerned in the plan and erection of the buildings, and in the construction and execution of the machinery. We now present our readers with a *Plan* and *Section* of one of the water-wheels, and forcing pumps, engraved for Carey & Lea's edition of Nicholson's Operative Mechanic, from a drawing made by Mr. Graff. The accompanying description will be sufficiently full for those who understand the general structure of hydraulic machinery; and for that portion of our readers who have not this knowledge, we shall hereafter enter more particularly into those details which may be desirable to them; and we shall then have occasion to advert again to the accompanying plate, as we shall give a horizontal section of the pump, to exhibit the arrangement and action of the valves.

The pump is what is called the double forcing pump; producing an equal effect in raising water, in whichever direction the piston moves. The working barrel is 16 inches diameter in the clear, and the half stroke of the pump is 5 feet, giving 10 feet stroke for each revolution of the water-wheel, of which there are 13 in a minute. The water is forced to a perpendicular height of 96 feet, through mains of nearly 300 feet in length. The quantity raised, by one pump, in twenty-four hours, is upwards of $1\frac{1}{3}$ million of gallons, ale measure. The reservoirs are elevated fifty-six feet above the highest ground in the city.

A, plan of the water-wheel.
B, crank wheel.
C, connecting rod from the wheel to the pump.
D, plan of the pump.
E, the forebay, which supplies the wheel and pump with water.
FF, the gates to the forebay and water-wheel.

Some account of the late James Cross, *a journeyman Weaver, of Paisley, in Scotland.*

We have for some time past intended to devote a page or two to the memory of this talented and neglected individual. The following account of his merits, and of the treatment which he experienced from those who were enriching themselves by the use of improvements introduced by him in the art of weaving, is extracted from a spirited and interesting article "*On the necessity and the means of protecting*

needy genius," published in the *London Journal of Arts and Sciences*, for May, 1825.

When men lose their lives while engaged in deeds of noble daring, or in the prosecution of perilous enterprises, undertaken for the advancement of science, imagination illumines their graves with a sacred halo; even although they may perish, unseen, in the lonely desert, their setting sun still leaves behind, traces of glory, which, while we mourn the departed, afford us some consolation; but when an individual, whom nature has richly endowed, becomes the sport of fortune, and ultimately sinks into his dark grave, neglected and destitute, we feel poignant and unmitigated regret, at the recollection of his career, and his fate.

That mass of suffering in Great Britain, which now presses, not upon the operatives only, who are dependant on their daily labour for the means of living, but also upon their more wealthy employers, was, at the time of the decease of Cross, unfelt, and almost unanticipated; and were we ignorant of the history of human nature, and of the influence on society, of a redundant population, our surprise, when reviewing the case now submitted to notice, would equal our regret.

Whilst we rejoice in our own comparative exemption from the misfortunes which now weigh so heavily upon our transatlantic brethren, we should be careful to trace this exemption to its true source. Let us not arrogate to ourselves a superiority in virtue, merely because we are spared the evils, which result from entailed vice in government, and from an overflowing population. The blessings which we enjoy, should call forth our gratitude without exciting our vanity. Much of our practical independence, arises from a facility in changing our pursuits, and our places of residence, which is elsewhere unknown; and which is one of the blessings consequent on the extent and fertility of our country.

We might indulge ourselves in a continued train of reflection suggested by this subject, but our readers will probably prefer the narrative to the essay, and we, therefore, proceed to the extract.

"James Cross, the unfortunate and injured sufferer, was a humble mechanic at Paisley. At various times he had effected many important improvements in the weaving machinery, used for figured fabrics, which, by his unwearied application, he at length brought to such perfection, as with other great advantages, to render unnecessary, the use of draw boys. During the progress of his labours, he was frequently encouraged by the manufacturers of Paisley, who saw and fully appreciated the value of his genius, with hopes of ample remuneration for his persevering application. But when the inventions were pronounced complete, and *more than* his little means had been expended in arriving at this perfection, his only recompense was the high *verbal* approbation of his *munificent* and *benevolent* patrons; and that, too, *after they had been entirely satisfied by actual experience of the great worth of the inventions, and were daily reaping benefit from them.* The Board of Trustees for the improvement of manufactures in Scotland, awarded poor Cross a hundred guineas, which alone is a convincing argument in his favour; but this *liberal* gift was sunk in the perfec-

ting of his invention, and even then the poor victim was involved in debt. Unable to sustain such a pressure of accumulated misery, his health, previously injured by the privations he underwent to gather the means to prosecute his work, gave way to anguish and blighted hopes; and after more than twelve months lingering in expectation of at least a partial fulfilment of the brilliant prospects which had been held out to him, he died the broken-hearted sacrifice to avarice and base ingratitude, leaving a young, helpless, and motherless family, to inherit his PENURY and his FAME.

——— "What man seeing this
"And having human feeling, does not blush
"And hang his head, to think himself a man?"

"Mr. Cross's numerous inventions form a grand æra in the history of the art of weaving, and will be admired by posterity when the name and the woes of the humble author will have sunk together to oblivion; but we can here only give a brief outline of them. So early as 1804, he first commenced his observations upon the defects of the machinery then used for weaving, and almost every succeeding year his fertile genius produced some valuable improvement. In 1817-18, he made the first working model of his machine for weaving harness-work without the aid of draw-boys, and submitted it to the inspection of a number of manufacturers and operative weavers, who unanimously spoke of it with the highest encomiums.

"This model being on rather a contracted scale, and necessarily imperfect, he was strongly recommended to construct one of larger and more serviceable dimensions, and was given to understand, that his advisers would cheerfully pay every expense, whether or not his attempts were successful.

"Thus encouraged, he proceeded in his labours; but from many untoward circumstances, they this time proved unsatisfactory, after incurring an expense of £18 15*s*. 6*d*. To defray this, as he had been promised, a subscription collected amongst the manufacturers produced £12 15*s*. 6*d*.—leaving him a loser of £6, besides much valuable time. Notwithstanding these losses and frequent interruptions, from his very weak state of health, by persevering industry, during every moment's respite from disease, in 1820, he erected a larger machine. This he submitted to a committee of manufacturers and weavers, who very highly approved the principle, and *warmly* recommended a meeting, to 'consider the propriety' of remunerating him.

"A subscription for the purpose of enabling him to prosecute his labours yet farther, was the consequence of this meeting, and the *liberal* amount of the collection was £16 7*s*. 6*d*. from which poor Cross had to pay for wages, &c. upwards of £12. With the residue he was to "*prosecute his labours*,' and maintain his family (then six in number, and entirely dependent on him) for five months. Subsequently, being blest with a short return of comparatively good health, and yet undismayed by the pitiful encouragement he received, he finished another machine of more extended and perfect operation. This also, he laid before committees of weavers and manufacturers.

They were now so fully satisfied of his merits, that they this time gave *written testimonials* of their approbation; (one signed by eighteen, and another by fifteen individuals) and a general meeting was called to *reconsider* the propriety of rewarding him, to which the public were invited, by a circular letter *widely* distributed. At this meeting a statement* of the poor sufferer's numerous inventions was read, as also the flattering reports of the weavers and manufacturers, who had witnessed the operations of the completed machine; and the weavers were examined, who then had it in actual practice. A subscription again succeeded this parade of mock generosity, and produced the magnificent sum of £3 1*s*. 6*d*. Such was the noble fulfilment of all the enticing prospects held out to him—all the generous promises which induced him to sacrifice time and health, which might, and would otherwise have been employed advantageously for himself and family.

"In making the numerous experiments necessary to enable him to bring the invention to perfection, he expended money and contracted debts exceeding 100*l*. exclusively of the maintenance of his family during the long period that he was so engaged, and for this, the whole recompense he received from the manufacturers, amounted, as we have shown, to 31*l*. 14*s*. 6*d*.! He now became but too fully sensible how miserably he had been deluded, and oppressed by all the horrors of debts, which he saw no possibility of repaying: harassed by continual anxiety, both of body and mind, and the bitter conviction of his utter destitution, his energies gave way beneath the accumulated mass of wo, his enfeebled body became the prey of sickness, and he sunk into a state of entire helplessness. Thus he lingered, the miserable victim of his own powerful genius, till March, 1824, when, at the early age of 45, he was happily released from further earthly trouble. Previously to his death, he had the satisfaction of seeing his machine generally adopted by the *liberal* manufacturers, and several gave *written testimony* of the great benefit they derived from it.† The *noble* donation of the Board of Trustees came to cheer his

* Extract from the report of the manufacturers, &c., being the statement alluded to:—

"Amongst the many improvements which Mr. Cross has made for the trade, may be mentioned—The Eyed Standard for Gauze Mountings; the Back Hiddles for Pressure Harnesses; the Barrel Machine and Harness; the extending Tail for double Harness, for contracting the flowers, which in many cases, saves nearly one-half the expense of flower lashing, the pressing treddles, not being required as formerly.

"These have all been proved to be of great use."

† Extract from testimonies alluded to:—"The counterpoise, harness, and machine, has, in my estimation, a number of decided advantages, too many and important for any commendation on my part. In short, and in truth, I am so highly satisfied with the invention, that I do prefer it to all others for the same purpose, *and even to a draw-boy free of expense.*

Signed, William Clark."

"I shall only add, that I am perfectly satisfied with the machine, in all its departments; that I look upon it to he a highly useful invention, and shall ever

latter days also, but it was too late to renovate his worn out frame. But for the real benevolence of one individual, his four orphans, (three girls and a boy, the last but six years old,) must have become entirely destitute, and have suffered the very extreme of want. By his humane aid, however, and the employment of the eldest girl as a servant in one of the manufactories, as far as the calls of nature go, they are perhaps as well provided for as many of their neighbours in the same class, but not one of them has yet received *any education whatever*, and unless benevolence again exert itself, there seems no possibility of their ever obtaining it."

Mode of Digging a Canal During Frost.

The Polish General Sokolnicki, has given to the public an account of the manner he pursued in making a canal in the middle of winter, when the earth was frozen very deep, for the purpose of draining some ground in Poland.

The canal was traced out in the autumn with a strong plough; the borders were dug out three or four feet deep, and the space filled up with dung and a considerable quantity of straw; the surface was also divided by the plough into squares of three feet, for the purpose of determining the size of the blocks of earth which he intended should be removed; and, lastly, he prepared, at certain distances, inclined planes, that the sledges might go down to the bottom of the intended canal, which was to be four or five feet deep.

When the winter was set in, the ground sufficiently frozen and covered with snow, the excavation of the canal was begun. The workmen were directed to dig, with long pick-axes, trenches running horizontally under the frozen ground, and to introduce a sledge; wedges were then driven into the furrows, that had been made by the plough, when the ground was divided into squares; and the block being thus separated, settled upon the sledge, and was drawn away immediately, by teams of horses, and placed on the neighbouring fields to serve as manure.

In this manner he completed in three weeks, at the expense of about £280, a canal, for the execution of which, by contract, he had been asked upwards of £4000 sterling.—*Mechanic's Weekly Journal.*

Vandal's Calefier and Refrigerator.

A patent has been just obtained by Mr. Vandal for a new construction of apparatus for heating and cooling fluids, which appears to be

feel grateful to Mr. Cross for his important exertion. I can now work when I please, and I am certain at all times of getting the work well executed.

Signed, JAS. FLEMYNG."

"I am ready to declare, without the smallest hesitation, that the machine so completely answers my purpose, that I esteem it infinitely preferable to all others, and would not exchange it for any draw-boy whatever, free of all charges.

Signed, JOHN MACPHERSON."

most effective in its operation, and far exceeding both in simplicity and economy any contrivance for the same purpose that we have before seen. It consists of two channels in contact with each other, the one, for the passage of wort or other heated fluid, the other, for cold water. These channels may be made of any breadth, by uniting thin plates of copper, but must be extremely shallow, that is the fluids must be distributed into very thin sheets, and pass over an extended surface, the length of the channels being made proportionate to their thickness.

We have seen wort received into the apparatus through pipes from the boiler at nearly a boiling temperature (170° Fahr.) and the cold water conducted into the other end of the apparatus from a well. On the wort discharging itself, after merely running through the apparatus, its temperature was reduced to 60° Fahr. and that of the cold water raised to 160° Fahr. which water it is proposed to conduct into a boiler, ready for the next mashing.

The form of the apparatus may be varied; its passages have been turned in a zig-zag, and also in a convolute curve; the principle consisting, not so much in the shape of the apparatus, as in its proportions. It has, we understand, been applied with considerable success to a steam-engine, as a condenser; but, in our opinion, it will not enable the air-pump to be dispensed with, which would be desirable, if possible, in consequence of its expensive construction, and its acting as a minus power on the engine.

As a condenser for distilled spirits, we have every reason to believe the apparatus will be found extremely valuable, having seen it applied in that way to the condensation of steam, and finding an equal quantity of distilled water discharged to that employed for cooling.

When the specification of this patent is enrolled (which will be in February) we shall take the earliest opportunity of laying it before our readers. [*London Journal of Arts.*

MECHANICS' SOCIETIES.

ASSOCIATED MECHANICS AND MANUFACTURERS OF NEW HAMPSHIRE.

We have received a copy of an address delivered before this society, on their 24th anniversary, which was celebrated at Portsmouth on the 5th of October last. The address was delivered by Abner Greenleaf, a member of the society, 'one who,' according to his own declaration, 'has been trained to the hammer, and whose means of acquiring an education have been otherwise extremely limited.' The whole address is creditable to the head and heart of the writer, and manifests considerable reading and industry. We should like to possess a copy of the constitution of this, and of all mechanics' societies in our country; in order that we might abstract and publish, such of their provisions as should appear most worthy of imitation, and which might serve as a guide in the formation of similar institutions.

PETERSBURG BENEVOLENT MECHANIC ASSOCIATION.

We do not know at what period this society was formed; it is however of many years standing; an act incorporating it, was last year passed by the Legislature of Virginia.

The society possesses a library, which is for the use of the members. They have also established a school for the gratuitous instruction of their children and apprentices, who have also, under proper regulations, free access to the library.

Apprentices of members who have served out their time with fidelity, receive certificates under the seal of the society, recommending them to encouragement and patronage, wherever they may sojourn.

French Patents, 1826.

To Berthol and Mariot, Chalons-sur-Saone, for improvements and additions to their patent of invention for the construction of roofs, ceilings, &c. 10th February—15 years.

P. Badeigts de Laborde, Saubuse, Dept. Landis, for an addition and improvement to his invention of an apparatus to manufacture essence of Thurbentine. 6th August—10 years.

Paturle, Lupin and Co. and C. A. Seydoux, Paris, rue Lepellitier, for improvements and additions to the patent of invention, for a machine called "Vaudoise," to comb wool. 7th April—15 years.

To F. Favre, Nantes, Department inferior Loire, for his invention of unalterable printing, or calender rollers. 7th April—5 years.

Madame Breton, Paris, for an improvement in nursing-tips. 30th June—5 years.

P. Masnyac, Lyons, Department Rhone, for improvements and additions to the patent of invention for manufacturing hats with feathers. 12th August, 1824—5 years.

M. Jongh, Warrington, England, for his importation of machinery to spin wool. 7th April—15 years.

J. F. H. Lamorineire, Paris, for improvements and additions to the invention to manufacture bricks, tiles, &c. 21st September, 1825—10 years.

J. C. Cloue, Paris, for his invention and improvements to Lithographic presses, 24th April—5 years.

Joanne Brothers, Mauzin, and Lewnite, Dijon, Department Coté d'Or, for improvements and additions to the invention for machinery to drive boats up rivers. 8th December, 1825—15 years.

J. G. Decaudin, Paris, for his invention of machinery to manufacture fringes. 24th April—10 years.

Madame Renaud Bainville, Givannis, Department Ardennes, for her invention of a machine called "Pluseuse," to clean wool. 24th April—5 years.

L. Dumery, Paris, for his invention of an improved water-wheel. 24th April—5 years.

P. A. Frichot, Paris, for his invention and improvement in the construction of rolling-mills, for the manufacturing of steel perles. 24th April—5 years.

Fleishinger, Paris, for his invention of a machine to grind colours in a dry state. 24th April—5 years.

J. Collier, Paris, for improvements and additions to his patent of importation for a power-loom, to weave woolen cloths. 31st December, 1823—15 years.

J. F. Marchand, Paris, for his invention of a cutter for washers, and nuts to bolts. 24th April—5 years.

J. C. Virton-Huet, Paris, for his invention of corn-batting machines. 24th April—5 years.

P. Deservisilles, Rouen, Department Seine-inferieure, for his invention of an apparatus to singe stuffs. 28th April—15 years.

A. T. Ganoel, Rouen, Department Seine-inferieure, for his invention of a machine economically to wash wool. 28th April—5 years.

Englorth, Realeaux and Dobbe, Eschweiter, Department Ardennes, for their importation and improvement of a fulling-mill. 28th April—5 years.

To B. Rotch, London, for his importation of a process to spin and twist silk. 28th April—15 years.

E. Delcambre, Paris, for his invention of a mechanical process to sift mineral or vegetable substances. 5th May—15 years.

I. Garnier, Isle of Olivon, Department Charente-inferieure, for his invention of a distilling apparatus. 3d May—10 years.

G. M. Chumette, Lyons, Department Rhone, for his invention of balancing ink-stands. 5th May—10 years.

Chalmas and Barret, Lyons, Department Rhone, for their invention of a carriage with three wheels. 5th May—15 years.

A. Douet, Junr. Tour, Department Indre et Loire, for his invention of a paste "vennicelli," he calls "analepetique." 5th May—5 years.

I. Christofle, Paris, for his invention to manufacture metallic buttons. 5th May—5 years.

L. G. Brocot, Paris, for his invention of a clock motion, with escapement, &c. 5th May—5 years.

J. Haywood, Weymouth, England, for his invention and importation of a steam apparatus to boil liquids. 5th May—5 years.

J. P. Dupon, Paris, for his invention of a chimney he calls "gazofumivore." 3d May—15 years.

M. Lorillard, Nuits, Department Coté d'Or, for his invention of a machine to bore holes in planks, to receive empty bottles. 5th May—5 years.

J. Heathcoat, Tiverton, England, for improvements and additions to his patent of importation for moving the bobbins in the bobbin-net machine. 14th September, 1825—15 years.

C. I. Andrieu, Paris, for his invention of a certain machine to be set in motion by certain gas, instead of vapour steam. 5th May—15 years.

THE

FRANKLIN JOURNAL,

AND

AMERICAN MECHANICS' MAGAZINE;

DEVOTED TO THE USEFUL ARTS, INTERNAL IMPROVEMENTS, AND GENERAL SCIENCE.

FEBRUARY, 1827.

FOR THE FRANKLIN JOURNAL.

A description of the American Marine Rail-way, as constructed at New York, By MR. JOHN THOMAS, *Naval Architect. With explanations of its principle, and manifestations of its safety for ships of war. By* JOHN L. SULLIVAN, *Civil Engineer.* [With two copperplates.]

To the Frankin Institute of the State of Pennsylvania.

GENTLEMEN,

The Marine Rail-way has become a subject of interest to the public, both as regards national, and private economy. Public opinion, which your institution is calculated to enlighten on subjects of mechanical philosophy, being founded in experience, as well as principle, in testimony, as well as practice, it cannot but be satisfactory when one peculiarly qualified to bear witness, is brought thus before those who are so competent to judge.

The inventor of the *American marine rail-way** has not only the advantage of being a practical mechanic, but was brought up in the best school of practice, the naval dock yards of Plymouth, in England, where he served also twenty years, as master shipwright; and perhaps no other man in our country, has had an equal opportunity of forming a correct opinion on the comparative advantages of the marine railway, and the dry dock.

In thus inviting your strict investigation of his improvement as arbiters between him and the American *commercial* interest, he comes before you with the uncommon advantage of not offering a mere project, however ingenious, but of showing you a machine, greatly useful, reduced to practice, operating with perfect success, and producing ample profits.

* Called in the patent, *the Rail-way Dock.*

In a *national* relation, it may be equally useful; because from Long Island to Pensacola the soil is alluvial, and it may be of consequence in public economy, to find an unexceptionable substitute for the dry dock.

If the old custom of heaving ships down, be detrimental to our mercantile marine, built comparatively strong, how much more so must it not be to ships of war, containing at least, eight hundred joints, not one of which, can safely bear to be strained.

The object of the rail-way dock, is to take the ship, as by surprise, while afloat, and before she loses the support of the water, to surround her with other supports, give her keel a firm foundation, her bilge a cradle, and her bends a general and substantial shoring. Without the least change of figure from that she had in the water, she is taken out of it, and being put in complete order, is gently returned to her element.

If it were a question of comparative actual expense, between hauling up a frigate for a *medium repair*, requiring 90 days, or to place her for the same purpose, in a dry dock, Mr. Thomas thinks, from his experience, that the following would be a fair calculation.

To haul up the frigate on the rail-way, - - - -	$15
To let her down, - - - - - - - - - - - - - -	3
	$18

To place a frigate in a dry dock, - - - - - - -	$45
To undock her, - - - - - - - - - - - - - -	17
Labour, hoisting up and lowering down, old and new materials, 10 men, 90 days, at 1 dollar per day,	900
Pumping dock 3 times a week, at 16 dollars, - -	208
Loss of time for want of light in dry dock, morning and evening, - - - - - - - - - - - - -	100
	$1270

Saving each time, or in this ratio, $1252.

Besides this, the work is best done in the light and air, and an additional value is thus conferred on the whole ship.

A marine rail-way, is indeed of easy device and construction where the tide retires far enough to lay it down on the dry bottom, and where, as in Scotland, the object of it is to receive small, or flat ships, but it is far different, when sharp and large ships are to be safely received, and the greater part of the work is to be done under water. This is the case in all our ports in the middle and southern States, and such is the description of the American mercantile marine. Even many of our coasters, are ships of three hundred tons.

An account of the origin of the first rail-way dock in our country, may be the most suitable *preface* to its description; and the public, may yet owe much to the discernment and enterprise of a few of the

largest ship owners at New York. These gentlemen* knowing the disadvantage to themselves, and others, of heaving down ships, associated to apply for an act of incorporation to build a dry dock, rather than continue that practice. But as it was known to be a very difficult structure, especially as the rise of tide is there but five feet, and a coffre dam would be necessary, it required a large capital to undertake it; and so incalculable was the expense, as to need the encouragement and protection of an annexed privilege of so much value as to balance any possible loss. The Legislature, composed of agriculturists, and of commercial men, were not slow to perceive the advantages of this public accommodation, nor the equity of guarding it, as proposed.

The difficulty, as well as expense, of constructing a coffre dam, and a recollection of Morton's marine rail-way in Scotland, had led Professor Renwick, of Columbia College, who had been consulted as a civil engineer, to advise the company to substitute that invention for the dry dock.

Knowing only that the company was deliberating on the best means of effectuating the purpose of their charter, I wrote to recommend Thomas's rail-way dock to their attention, and subsequently explained its principal features, personally. Upon the representations made to them, the board of directors came to the resolution of building one; and immediately employed Mr. Thomas to construct a diving bell, and to make other preparations. But some of the proprietors were not fully satisfied, and a gentleman, going to England, was commissioned to visit Scotland, to see Morton's invention, and to collect more minute information upon the subject.

On his report, the board again submitted the subject to the judgment of Mr. Renwick, and as the decision of a person so highly qualified, will be a valuable testimonial before the Institute and the public, especially as its candour bears honourable testimony to the integrity with which he executed his trust, I shall presume to offer a quotation from his letter to the Board of Directors, dated the 10th of December, 1825. At page 9, of its printed copy, he says,

"A vessel even of the largest size will be much more free from risk of injury upon a rail-way, than in a dry dock. On the first, she may be completely shored and supported, before her original water borne state is changed; in the last, the application of shores is a difficult and hazardous operation. This advantage, which is in some measure possessed by all rail-ways, is much increased in that erecting for the company, by the improvements that Mr. Thomas has introduced in the *form and structure of the carriage.*

"And here I would state, that I entered upon the examination of that part of the subject, with strong impressions against any alteration from the original plan of Morton, so much so, that I did not hesitate to condemn the works already constructed, merely in consequence of this deviation. In his inclined plane, the vessels are supported upon the

* T. H. Smith, F. Thompson and others.

carriage, by wedges, and this method has been found sufficient for the vessels, of that part of the world. These vessels, as I am well aware from personal examination, are very different in mould from our merchant ships, and still more different from our ships of war, and fast sailing craft. But even in the full built, and flat floored ships of the northern parts of Great Britain, it is evident that the process of relaunching cannot be performed, until all the wedges and shores aft of the midship frame shall have been removed; and in sharp vessels, both the aftermost and foremost sets of wedges will be found difficult of application, and to add little to the security of the vessel. Wedges also appear to be ill fitted to allow of the change of figure that takes place in all large vessels, when they pass from the state of floatation in water to that of resting upon their keels. Impressed with these difficulties, Mr. Thomas has proposed and prepared to carry into effect, such a modification of the rail-way carriage as shall permit the vessel to be supported by stays and shores, as when upon the stocks, instead of resting upon wedges; in this change, I, after mature deliberation, fully concur with him."

While thus adducing such valuable testimonials as are calculated to satisfy the public, (if the Institute should so far approbate the improvement, as to make their Journal its medium to the public eye) I should do the subject injustice, were I to omit to mention the good opinion, also, of the merchants of Philadelphia, decidedly, and unanimously, expressed by a committee of the chamber of commerce, whose attention was drawn, as it passed through the city, to a model of the rail-way dock, ordered by the honourable the Secretary of the Navy, to be made for the use of the department.

On this occasion I ought not to omit the experimental confirmation of the judgment of Mr. Renwick, soon after his opinion was pronounced. I allude to the fatal accident of the ship Panther, which fell over, and was wrecked, at Salem, on a Morton's rail-way. The wedges, being drawn under her bottom upon the cross timbers, could have no other support than those timbers; and should only one, two, or three of them, along midships, have taken the weight, and yielded, however little, the inclining pressure of the ship at the same time must be augmented by the leverage of all that part thereof, overhanging the wedges, which are thus converted to *fulcra*, and the superincumbent weight, to an active force. The danger that the cross timbers will break down, or the ship break in, and thus fall over, becomes imminent, and this accident actually happened, as above stated.

Of the construction and advantages of Thomas's Rail-way dock.

The process of constructing the rail-way dock requires, first, the regulation of the bottom, if so shoal as to interfere with the intended slope of the work; or it may be excavated within the shore, with the proper slope, if a channel should prevent its extension.

The foundation piles are to be driven in four lines; the two inner rows, near to each other, in order to support the keel, the two outer rows, to come under the shores.

The distance between the piles, will be determined by the size of the timbers which bear the iron rails.

The size of the timber, will depend on the burthen of the largest ship which it is contemplated to haul up. Four feet apart, in the centre line, will be generally sufficient; in the side lines, eight feet.

Buffon's experiments appear to be the foundation of the practical rule for computing the transverse strength of timber; which rule is, after much elucidation, given by Dr. Robison, in his System of Mechanical Philosophy, vol. I. According to this rule, an oak stick, 1 foot square, propt every 4 feet, will bear, before breaking, 113 tons, and will not bend with 37 tons.

The piles to be cut off under water, must be cut in the exact inclination of the plane, and level with each other, transversely. The necessity of previously marking every pile separately, on every side, in accordance with the intended inclination of the ways, led to the invention of instruments requisite to the occasion.

An aerial inclined plane, parallel to that intended to be established under water, is obtained by first fixing a true level across the head of the rail-way, and denoting each station by a target, the staff of which is as much above the line of plane, as will bring the lower end of the aerial plane, above water. Targets, having each a staff of the same length, being next applied and nailed to the outer, and some few to intermediate piles, will exactly indicate the aerial inclined plane, while the point of the staff attached to the pile, will indicate a point on one side thereof, in the intended plane of the foundation.

The level and bevel, is an instrument, by which to ascertain every other point on the sides of the pile, that will be in the intended plane. (Fig. 6, e.)

The diving bell may now be supposed to be brought over the pile, and as much of this as it will take in, cut off, together with the target staff, still leaving its lower end. This cutting is repeated till the workmen arrive in the bell, to the bottom of the staff, which remains a little below the last rough cutting. The level and bevel is then set on; this consists of a *base board* with a post arising from its centre to support a plumb line, playing in a comb-piece having a centre notch, to determine when the base is level transversely; and as this base is at the same angle with its post, that the intended plane is, to a perpendicular line, and the base being equally thick, its under side also indicates a parallel plane, so that being secured in its place, the distance is measured by compasses from the *ascertained point* to the base board, and thence to every point in the circumference of the pile, that is also in the intended plane; thus *marking it*, with accuracy for cutting. This operation being the same for each pile, it results that every one must be truly in the intended inclined plane, ready to receive the frames of the rail-way, which are floated over, and sunk down to their places; or a plank is first secured upon the head of the piles, upon which the frames are successively slid down.

The iron rails, will, in point of size, depend on the weight they are to bear. They must of course, spread a sufficient base, to prevent being indented into the wood by a heavy load. The two middle rails,

and the rack piece for the *palls*, are generally cast in one. But if the rails are to be of rolled iron, the rack will be separate. The palls prevent the ship from accidentally running back.

The pressure of the load, will, in the merchant ships, be greater forward and aft, than at midships, because they generally become a little hogged, provision therefore must be made for this contingency, and it will be safe to suppose cases, in which the largest class of ships to be received, will bear all their weight on the first ten feet forward, and the last ten feet aft.

The weight of a ship is often, erroneously, stated to be as many tons as she measures tons. The fact is, that when loaded, she displaces a quantity of water that would precisely weigh her whole weight, cargo included; and as she generally *carries* as many tons as her measurement, she cannot, when light, weigh as many tons as she measures. She weighs only as much as the water she then displaces, and this will be in accordance with her heavy or light materials, oak, pine or cedar. Wherefore, for explanation, I shall suppose the positive weight of ships, to be one-half of their nominal tonnage.

A ship of war will be received upon a rail-way carriage with the precautions to be subsequently explained, and its weight distributed equally over it, and the foundation. The tendency of all ships being to acquire some curvature of keel, it will generally be injudicious to straighten them on the dock, as they will resume their lines on being again put afloat, opening thereby the upper seams, or butts. To keep the ship, when taken out of the water, in precisely the same shape she has in it, the curve of the keel must be ascertained, and the keel blocks be made to conform thereto.

To measure the curvature of the keel, we have devised an instrument, consisting simply of a bar, suspended at each end by a graduated chain. This bar being long enough to reach across the ship, is passed under, and across her centre, at every five or ten feet, when the graduations on the chains will show the difference of depth at every point of contact, from stem to stern. For merchantmen, this precaution will not generally be necessary.

A ship of five hundred tons measurement, will exert a pressure of 250 tons; and we have supposed the whole of this may have to be borne by the two extremities of the carriage, or by ten feet at each end. The axles, therefore, are at the extremities, put *nearest* to each other; but as steam boats will bear heaviest in the middle, the axles must be *near* in the centre also, for their support.

The axles will be two feet apart in the first ten feet. Five axles will have to bear 125 tons, or 25 tons each; the bearings and wheels $12\frac{1}{2}$ tons. The axles of the New York dock, are three inches diameter, and the square of the section is 7.071 inches. The bearings are close to the wheels, in which the axles are *fixed*.

The strength of the rail is deduced from the experiments of Rennie. By a very powerful lever, mounted for this purpose, he proved that a cube of one-fourth of an inch of cast iron, would not be crushed till loaded with 10,000 lbs., a square inch of iron, having sixteen times as much surface, will probably bear 160,000 lbs. or 70 tons. It

is obvious that the wheel will not touch the whole inch, but the adjacent particles will sustain those in contact; and probably the length of the rail, supporting the supposed square on two sides, it will bear more than it would in sixteen separate squares of one-fourth of an inch. A rail of one inch, however, is too narrow to be favourable to the duration of the wheels.

The wheels are considered as columns, as every section under the axle, may be computed in the same manner.

The bearing of the axle, being near the wheel, and the middle being somewhat enlarged, it may be computed to be able to bear in proportion to its diameter; the manner of receiving the pressure being such as not to bend the axle.

The *transverse strength of iron*, does not appear to have been experimentally ascertained on a large scale. Mr. Rennie's trials were on bars propt 2 ft. 8 inches apart. But from the analogy of experiments described in Robison, on other materials, which resulted in showing the transverse strength, when closely supported, to be greater than the strength lengthwise, as 575 is to 205: it will be *safe* to assume it to be double, in this position, to that of suspension. Now as a bar of iron one inch square is estimated to support,

According to Emerson 76,400 lb.
——— Robison 76,000
——— Rennie 74,821

The lowest of which is 74,821 lb. (33 tons) it follows that 7,071 inches would support 529,059 lb. and five axles, 1,181 *tons*, calling the two bearings one, because not closely supported on both sides, and instead of assuming the above analogy for position, taking as the rule only the direct strength of the iron.

This excessive strength seems to show that a part of the material might be spared. But in fact, the expense of this ample provision of strength amounts but to a small sum of money. The central axles of the New York Dock, weigh but about one ton, and would together suspend 9,300 tons.

The friction of the axles, should be relieved by the intervention of *brass bearings*, as usual, in machinery; and as Mr. Rennie's experiments proved, that a cube of brass of one-fourth of an inch, would not crush till pressed upon with a weight of 10,300 lb. it is demonstrable that this metal would stand well in this situation

The side axles will sometimes have a proportionate share of the ship's weight to sustain; though she will ordinarily be prevented from inclining to one side, or the other, by the *adjusting screw*, placed at the angles of the shear shores; yet it is necessary to guard against the force of high winds, and the weight which a hogged ship may sometimes throw on to the centre shores, before she is *eased down* at midships by the screws, if intended to be straightened. (Fig. 3. i.)

The carriage is combined in a very strong manner; though it appears to be rather a light structure for its purpose. In its construction, the implement called the dowelling bit, as improved by Mr. Thomas, is of great, and essential, use. (See Fig. 5.)

The dowell, you will recollect, is a cylinder of some hard wood,

(generally lignumvitæ,) which is one half inserted into one, the other half into the other timber where a joint is to be made of their surfaces, which the dowell prevents from moving, or sliding, on each other. To make the *sockets*, for its reception, was heretofore so laborious an operation, that few dowells were used; but they are now applied very easily. The gouge and the screw, perceived on reference to the plate (fig. 5.), are Thomas's improvements. An auger hole, a little smaller than the screw of the bit, being first bored, the thread will cause the bit to advance, as fast as its chisel and gouge can conveniently cut, and thus the whole labour is confined to turning it.

This instrument now makes it easy to dowell the frames of a ship, the knees to the timbers, the water ways to the beams, the thick stuff of the wales to each other, and generally to bind the ship by a solid connection of wood. This instrument, thus improved, has, as I am informed, been adopted into all the navy yards of the United States.

By means of irons and the dowell, the *cross ties* are secured to the cills, in such a manner as to make it impossible that the carriage should spread; and by thus tying the sides to the centre, the cross timbers convert the oblique force of the shores, into vertical pressure; and care is taken, in every instance, *that a wheel shall stand directly under the base of every shore.*

The shear shores (fig. 3.) have a form which gives them great stability in their places, and answers other purposes, to be mentioned; they are based in *hollow coin blocks*, either of wood or iron, divided across the middle of the hollow, by a partition, which serves to hinge the two legs of contiguous shears. There is thus a continuity of *solid material* from the side of the ship to the foundation, from the moment she ceases to float, till she is high and dry.

The shear shore screws, will sometimes have the important office, when ships are old and tender, of taking a good share of the weight of the ship's side, and distributing it along the carriage side, taking it off from the floor timber heads, futtocks, and beam-ends, where ships are most liable to be weak.

The bilge levers, (fig. 3.) are levers of the second class. One end is lodged fixedly on the centre cill of the carriage, while the other end is hove up between the legs of the shear shores, by a windlass placed within them. The moving end is guided in a slot of the prop, and sustained when up to contact with the bilge, by means of an iron pin passing through the cheeks of the prop.

The cradle thus formed by the bilge levers, it is evident, *will fit every successive vessel equally well*, and may be removed, singly, and replaced, as the work progresses. And, as they require to be hauled up with considerable force, nothing can be desired more convenient than these shears.

The common keel blocks are of course placed between the cross ties, and are of such height as to allow ample room for the shipwright to work under the flat of the bottom, standing between, and on the cross timbers. But the bottom of the keel will sometimes have to be repaired; to accomplish this end, the instrument, called the Lifting Plane, has been devised. (Fig. 4.) In the operation of this machine,

two wedges are forced on by percussion; blows from opposite sides being simultaneously given, with the combined strength of a considerable number of men, when the resistance renders it requisite. As I conceive this instrument to be an original invention, and (as it is patented) I deem its description likely to be acceptable in this place: though not a constituent, it is *an auxiliary* of the dock.

The lifting planes are composed of six pieces of timber; and for the navy, may be best made of cast iron, or of wood faced with iron. To make them, let us suppose a block 4 ft. long, and 16 in. square, halved horizontally; and each face of the cut marked lengthwise, and then shaped into two similar planes inclined in opposite directions; the two planes are then divided from each other by a bar of iron, let in edgewise, till its edge is flush with the upper ends of the two planes, in order to guide the wedges. Now let the upper half be placed in its original relation to the under one, (over it,) and there will be space for two wedges, pointing in opposite directions, parallel to each other, separated by the bar of iron before mentioned. The planes being eight, all at the same angle of inclination, the upper block, with whatever may be upon it, will be lifted *perpendicularly*, by driving the wedges. These require heavy blows, and for this purpose, battering rams swung each between two files of men, are necessary. (See Fig. 4. g. g.)

In practice, one of these machines, placed near a keel block, is easily made to take the pressure from it by the least degree of lifting; and thus several machines may be applied, so as even to take away all the common blocks, and they themselves may be readily withdrawn and shifted in position, so as to allow the bottom of the keel to be got at for coppering, shoeing or renewing; and when done, the common blocks are replaced. To do this *when a ship is hove down*, her keel must be hove completely out of water.

The chain, and compound windlass, by which the ship is hauled out, is an expensive and essential part of the machine. The experiments made in England, of late years, may enable me to illustrate the subject of the *resistance* to be overcome on *this* rail way.

The mean result may, it seems, be stated as giving for the requisite power, a horizontal force of the 1-200th of the load, on a *smooth, hard, level* rail way.

This resistance is compounded of the attrition of the rubbing surface of the axle, and the obstacle existing at the rail, to the rolling of the wheel. But however true, theoretically, that the friction must be diminished by large wheels and small axles, yet in the treatises of both Tredgold and Wood, it is admitted to be so inconsiderable, that the principle is established in practice, that the *friction is as the weight*, and that on a smooth, hard rail, *the rolling* motion meets with no calculable obstacle. Friction is proved to be a uniformly retarding force. Velocity does not increase it. Weight alone augments it; and very nearly in its own proportion.

The power to draw up a ship of 500 tons, weighing, as we have assumed, one half the same number of tons, is now to be considered. As the experiments in England ranged from the 1-60th to the 1-300th,

I shall, instead of 1-200th, say 1-100th of her weight is the ratio. To this we have to add the resistance from gravitation in ascending the plane.

The gravitating force of the plane will be to that of the whole gravitating force of the body, falling freely, as the perpendicular height of the plane, is to its length.

The elevation being 1-20, or 25 in 500 feet; if the ship weighs 250 tons, and the carriage 50 tons; ($300 \times 25 \div 500$) the gravitating force down the plane is 15 tons. To which must be added the $2\frac{1}{2}$ tons, for the 1-100th of the ship's weight, and $\frac{1}{2}$ ton for the carriage weight, on a level—which 18 tons is 40,320lbs. which the chain must bear: and we have stated, that a bar one inch square, of pure iron, will bear 74,800lbs

The chain of a marine rail-way must be, however, exposed to accidental stress beyond this calculation. It has to ply around a rotch wheel, and animal force is often irregular. A steam engine, whose power can be steadily augmented and controlled, would be the best, when its surplus power can be employed to other labour-saving objects as, for instance, the smithery of the establishment.

The shape of the chain, in order to give it a degree of strength proportionate to the material, is important, as it has to bear the stress of turning around the *rotch* wheel of the windlass.

The windlass is so geared as to adapt it to the power of a few horses: when they travel in a walk, the ship moves up the plane about three feet a minute, and she is completely up in less than two hours. Four horses are a sufficient force for a ship of 500 tons. The horses work in the second story of a small building; they are attached to bars 14 feet in length, proceeding from an upright shaft, on the lower part of which is a bevel wheel communicating with the rest of the gear.

The end of the chain is strongly fastened to the centre of the carriage, with branches passing obliquely to the sides, so that the whole must move equally, and at once.

The reversal of the draught, at will, is an essential provision, in order to draw the carriage out to the extremity of the ways, to which its own gravity would not *certainly* carry it. Because to be able to give the carriage such a position as to afford just water enough for the ship to ground on the upper blocks, is indispensable. To be able to refloat the ship, should she happen, by bad management, to ground otherwise than on the centre of the carriage, may, if on a falling tide, be of great consequence; we must therefore have the readiest means of drawing the carriage down the ways. With this view the chain, after passing the *haul up wheel*, is led to another rotch, with reversed teeth, and thence down along in a trunk, by the centre timber of the ways, till near their extremity; there it turns around a large and strong shiver, and fastens about twenty feet from the end of the carriage, which the chain follows when drawn up, it being supported on rollers. The reversed movement, of course, draws the carriage down, till it touches the stop timber, at the outer end of the railway. The chain is thus disposed of without manual labour. The connection of the second rotch with the first is by intervening gear, so that they move alike.

The ship in descending requires a controlling power, that she may not acquire momentum, and injure the carriage by velocity. The friction for this purpose, is produced by means of an iron wheel, on the upright shaft, placed just below the floor; an iron band is made to clasp this wheel, by the aid of a powerful lever; this is found to be quite sufficient, and very convenient.

The manner of receiving a ship, is this:—She is brought between the wharves of the dock, head on; the carriage is drawn down under her, and perhaps up a little, till her *forefoot* grounds on the forward block; and as ships generally draw more water aft than forward, she is *nearly* aground aft also. The head shores are applied, she is then moved up a few feet, until she is ascertained to touch aft also. The shores are now all applied, and secured, and the bilge levers are hove up to their bearing. She is now ready to rise into the light and air.

I here ask leave to anticipate a mechanical objection to the size of our wheels. *They are small*, because it is an object to keep the carriage *low*, that we may not have to extend the ways farther than is necessary to get the *desired depth* of water on the carriage. I am fully aware that it may be said, that *rollers* would be attended by less friction than wheels. True, but we could not employ them in a submarine movement. They cannot have fixed stations, because they cannot have axles: and if not kept at right angles to the way, they would incline aside. Above water they might be attended.—We must at present, however, content ourselves with our small wheels, according to the local situation, and the size of the ship to be received; waiting until greater ingenuity shall devise a better plan. There will be no difficulty in hauling up any ship on a smooth, hard, and true rail. I only insist that it would be *false economy, to slight* any part of this kind of structure, which is, of course, only accessible, for repairs, by the diving bell—unless, indeed, a frame is to be taken up, for which provision is made while putting them down. In all places exposed to the worms, the timber must be *coppered*, unless the *white gum tree* is found unassailable, as some have represented.

Of the expense, it is sufficient to remark, that every principle being within the rules of mechanical computation, it will not be difficult to make an estimate, when the ground is known, and the prices of materials settled. It will then depend on the size, and other circumstances of the work to be performed.

It may have thus been made to appear to the Institute, that the American Marine Rail-way, is as well adapted to the ports of the United States, as that of Scotland is to the northern ports of Britain. And from the united testimony of experience, and of science, that it is on many accounts, besides that of saving expense, *preferable to the dry dock.* It will give to steam batteries, contemplated in the late report of the Secretary of the Navy, as a branch of harbour and sea coast defence, likely to be increased, a facility of careenage and repairs, almost denied to them in any other method.

While, as an individual, I would not be understood to express the opinion that the dry dock may not be necessary for our ships of the line, yet I think, that it has been made to appear from this statement, that the marine rail-way is convenient, expeditious and economical, for

the smaller class of ships of war. It is peculiarly adapted to alluvial soils, such as the shores of most of our southern harbours. It is, at least, far more economical for our mercantile marine than the old custom of heaving down; and I am happy that complete success in the first example of this machine, in full practice, enables me, to submit it with confidence to your examination.

Respectfully your humble servant,

JOHN L. SULLIVAN.

Philadelphia, January 4th, 1826.

EXPLANATION OF THE PLATES.

PLATE. 1.

Fig. 1. *Ship on the Rail-way.*

a Windlass Loft—*b* Windlass—*c* Chain—*d* Shear shores applied.

Fig. 2. *Stern view of a Ship on the Rail-way.*

a a a The Rail-way—*b b b* Carriage wheels—*c c c* Carriage cills —*d d* Cross ties—*e e* Bilge Levers—*f f* Shear shores—*g g* Scaffold posts.

Fig. 3. *Perspective combination of the Shear Shores and Bilge Levers.*

a The ways—*b* The iron rail—*c c c* The wheels—*d* The cill—*e* The plank—*f* The cross tie—*g g* The hollow coin blocks—*h* The shear shore—*i* The screw—*k* The windlass—*l l* The bilge levers—*m* The prop.

PLATE 2.

Fig. 4. *The Lifting Planes.*

a The keel of the ship—*b* The upper block of the lifting planes—*c* The under block, do.—*d d* The wedges—*e, f* The block in different points of view—*g g* The battering rams.

Fig. 5. *The Improved Dowelling Bit.*

a The chisel, *b* The cutter,	old implement.
c The gouge, *d* The screw,	improved implement.

Fig. 6. *The under-water Implements, and Works.*

a a a a Piles—*b* Pile standing out of water—*c c* Piles cut off to the line of the plane—*d* Pile in the process of cutting off in the Diving Bell—*e* The level and bevel in the Diving Bell—*f* The batten and target—*g g* The æriel plane, parallel to the intended Plane—*h* The surface of the water—*i* Compasses—*k* The ground—*l* The intended Plane.

Fig. 7.

a The New York Chain—*b* Tucker's Improved chain.

ADDENDÆ.

An approximation to an estimate of the cost of a rail-way dock, at Philadelphia, for ships of 500 tons, and under.

The Implements (expedient to be preserved) viz: the diving bell, pile driver and their scow, cost at New York, - - -	$3,300
Various tools, - - - - - - - - - - - -	700
The Foundation Piles, the number and length of them will depend on the nature of the ground. Assuming that the number will be 300, and the materials and fixing at $3 each, is - - - - - - - - - - -	900
Frames to bear the iron rails, and connect all together 7,600 at 30 cents, - - - - - - - - - -	2,280
The Capstan House, two stories high, - - - - -	600
Iron Work, consisting of the rails, rack, saddle-pieces, axles, wheels, gear of the windlass, shafts, plummer boxes, levers, bolts and fastenings of every kind, according to experience in New York, - - - - - - -	12,500
The Chain is of a peculiar construction, 300 feet will weigh 20,400 lbs. at 20 cents, - - - - - - - -	4,000
Labour, driving the piles, and carpenters' work, estimated at	3,500
Land, and Wharves, will probably cost about - - -	10,000
Supervision, - - - - - - - - - -	1,000
	$38,780

If the same establishment should have a second rail-way, of dimensions suitable for ships of 200 tons and under, it may be built for the additional sum of - - - - -	$17,000

The Income from the principal Dock, besides the wharfage, may be estimated as follows; the rates of toll being placed at 25 cents a ton, as established in New York. If then one hundred vessels, averaging 200 tons, be drawn up in a year, it will amount to 5000 dollars. The expense of management must be deducted, but a reasonable income from the investment will still remain. The Dock would, however, be capable of doing more business, should the demand for its use be greater.

List of inventions belonging to Thomas's rail-way dock.

Blocks and wedges for gaining access to the bottom of the keel, patented May 17th, 1822. System of shoring, patented February 24th, 1826. Foundation Instruments, and Bilge Levers, patented November 6th, 1826. Authenticated specifications of the shear shore screw, and of the reversed movement, entered August 12th, 1826. An improvement in the rail way dock brake, May 7th, 1826; and in the lifting blocks, May 16th, 1826; for which patents are intended to be taken out, at maturity.

FRANKLIN INSTITUTE.

Report of the Committee of Inventions, on the American Marine Rail-way, constructed by Mr. John Thomas of New York.

The Committee of Inventions, to whom has been presented for examination, by John L. Sullivan, Esq. of New York, Civil Engineer, a description, with drawings, of a Marine Rail-way, exhibiting the improvements made by Mr. John Thomas, of New York, Ship builder,

Report—That they are fully satisfied, that the improvements made by Mr. Thomas add greatly to the security of a vessel when drawn up on Marine rail-ways, for the purpose of being repaired; and obviate most of the difficulties which have attended the hauling up, on ways heretofore constructed. The shear-shores possess a degree of stability, which gives them a decided advantage over those of the ordinary form, and the facility with which they may be applied and adjusted, appears to the committee a point of great practical importance. The support derived from the bilge-levers, is well calculated to prevent that injurious strain to which a large vessel is liable when removed out of the water, without having her bilge supported; these levers form a cradle, which admirably adapts itself to the shape of every vessel; whilst the facility with which these levers, and the shear-shores, may be successively removed, for the purpose of coppering, or of making other repairs, add much to their utility.

The committee do not enter into any particular detail upon this subject, as the description and drawings which accompany this Report, render such a detail unnecessary. The excellence of the structure is not a point of mere speculation, as a rail-way upon this plan has been in operation in New York, for several months, and, it is believed, has completely fulfilled the expectations of the proprietors. A great number of vessels, of different sizes, have been drawn up, repaired and relaunched, with perfect ease and safety. This rail-way was constructed under the direction of Mr. Thomas, and although it was the first trial of his improvements, his practical knowledge has been strikingly evinced, in the firmness of those parts of the structure, upon which the greatest strain falls, whilst the carriage is not loaded with a weight of materials, which does not add to its strength.

The superiority of *rail-ways*, to dry docks, in several points of view, is acknowledged by all who are conversant with the subject. The dry dock is by far the most expensive in its construction, whilst humidity, darkness, and want of room, interfere materially in carrying on the requisite operations, after a ship has been secured in it for repair. To obviate these objections by increasing the size of the dock, would, in most instances, add so greatly to the expense of building, and of using it, as to prevent, on the part of the mercantile community, every attempt to establish them.

ROBERT M. PATTERSON, *Chairman.*

THOMAS P. JONES, *Secretary.*

Philadelphia, January 10*th*, 1827.

FOR THE FRANKLIN JOURNAL.

Observations on the Floating Dock, invented by COMMODORE BARRON; _as described in the Franklin Journal for January,_ 1827, _and recommended by a Select Committee, to the Merchants of Philadelphia._

THE Journal of the Franklin Institute, being a free and open channel of information to the public, on all scientific subjects, and more particularly upon practical mechanics, the remarks to be now made on the Floating Dock, will, I hope, be considered as springing from a desire to promote its views. The publication of descriptions of machinery, for new and useful purposes, is intended to enable the public to appreciate them justly, by an accurate knowledge of their principles of construction and operation, and therefore of their cost, economy, and comparative utility. A frank and strict investigation of their claims, must consequently promote the objects of the Institute; nor will an expression of adverse opinions, be construed into disrespect to a committee of its appointment.

The personal, and professional, respectability of the committee, composed, as it was, of men esteemed able, as well as willing to investigate, and judge of an invention known by them to be a desideratum in our sea ports, would forbid a mere practical man from expressing the reasons of his doubts, whether they have not underrated the mechanical difficulties, as well as the cost, did not their individual characters, as well as the commodore's own elevation of mind, authorize the confidence, that they are open to conviction, if in error; or if they have been too much warmed by friendship, and an enthusiastic admiration of genius, that they will again deliberately, and calmly, consider the subject.

It is certainly very much to be regretted that Major Wilson, one of the committee, was not here when the report was finally made up, as he, probably, would have superadded, in his usual accurate manner, the dimensions, the quantity of materials, and an estimate in detail, of the cost; because *he* is well aware, from a long and highly respectable professional career, that the opinions of even the most eminent engineers are rendered valuable, solely by the confidence felt, that they are *ready to be demonstrated;* while, on the contrary, it is a tribute of respect, which the world pays to those engaged in other arts and professions, that their opinions are *implicitly received,* because the public *cannot* readily understand the grounds of them.

That in all the mechanic arts, there must be an adequate adaptation of the means to the end, is obvious. Our reflections on the *floating dock,* have not led to the conclusion that it is an impracticable project, but, with all the ingenuity displayed, a *very difficult one.* And perhaps the consideration of what appear to be the difficulties, will, if well founded, only prompt so able a mechanician as Commodore Barron, to devise some easy remedy for them.

Owing, it may be presumed, to the absence of *one* of the committee, as before mentioned, the report refers to the engravings illustrative thereof, for the relative proportions of the dock, and ship: and it is stated, that for a dock capable of receiving a ship of 300 tons, the ex-

pense need not exceed 4,400 dollars. Fig. 1. represents such a ship, in such a dock: the dock then must be larger than the ship. Judging from their proportion to each other in fig. 1—the chamber of the dock is two-ninths wider than the ship. A ship of 300 tons, may be 27 feet; the dock will then be 33 feet; the trunks each 4 feet; the depth of the dock must be 14 feet; its length 100 feet; its tonnage, carpenter's measure, 500 tons. Is there any reason why this dock should cost *less* than the hull of a ship of the same tonnage? Yes: It has no deck. But it has trunks, "*air tight*" trunks, its whole length; these are to be built on to the side, and must therefore be timbered, kneed, and bolted, as well as planked; and all this, may fairly be supposed, *at least*, to equal the materials and work of the deck of a ship.

But what reasons are there for building a floating dock as strong as a ship? The committee intimate that to guard the bottom against warping, it must be built with peculiar strength; the reasons for which are well known to ship builders, and nautical men. The tendency of all ships is to be become hogged, because the sharpness forward, and the leanness of the bottom aft, do not permit those parts to receive so much support from the water, as it gives at midships. The more frequent caulking of the upperworks than of the bottom, also, gives a fixedness to the curve, which the keel acquires. When such a ship (and all ships are such) enters the floating dock, she grounds, head and stern first; and if strong enough to keep her shape, her whole weight must be divided between her two extremities; unless, indeed, a few of the shores along midships, being applied as soon as, or before the water begins to leave supporting her, take some of the weight of midships. We must then have the weight of the whole ship, on either two, or four spots, in the bottom of the dock; either 75 tons, or 37 tons on each. Is the bottom in no danger of warping? If not, why in the marine rail ways do they so multiply the number of axles under the bow and stern, to receive the pressure above described? Who that observes their operation but will acknowledge the excessive pressure on the head block? Why is the support at the bilge, by levers, so highly thought of? Why is the degree of a ship's hogging sometimes ascertained, and the whole range of blocks on the carriage, made to conform thereto? Practice proves the fact, that this is necessary; and it is a very serious fact, for the floating dock, which, in addition to its want of *solidity*, cannot have its receiving blocks adjusted, without previous pumping out; thus making two pumpings necessary to one ship.

The Report states, that the sides must be very strongly joined to the bottom, with knees well bolted, and that for strength and shape, the dock is to be compared to a scow. There is this difference, however, that it is not nearly so strong, in proportion to its size, from its being open at one end. The angle made by the bottom and side, where the grub seam must be, is in all scows, the most difficult to keep tight; and the more so, the larger the fabric; because the fastenings relied on, are the iron bolts; but as the labour of man is never as effectual on large as on small work, the iron fastenings, there-

fore, in these strong knees, and thick stuff, will not be so embedded, but that they may *work loose;* especially by great stress.

That they are exceedingly exposed to this effect is demonstrable: for we must recollect that the bottom, loaded with ballast, is by them hung to the sides, and by them the whole weight of the ship too, added to this ballast in the bottom, must be sustained: that when the dock is full of water, and the *trunks* immersed by the weight of the ballast, as well as the body of timber of which the bottom is composed, they lift the whole, before the water is pumped out; nor do they lift perpendicularly, but their load is attached to the sides of the trunks; this tends to press the side of the dock inwards. When the ship is in, those of her shores which are diagonally placed, rest against the bottom; those placed horizontally, press the side outwards; at the same time the trunks, which, considering their office, cannot be very light, hang their weight on the outsides, co-operating with the shores to bend the sides outwards. Now these several forces, operating successively in different directions, outwards and inwards, upwards and downwards, pressing and relaxing, act upon those bolts, and tend to loosen them in the wood, and must gradually, if not quickly, produce this effect; an effect that must put an end to the tightness and usefulness of the dock. From these considerations, it is fair to conclude, that as the dock must be at least as strong as a vessel, it cannot cost less, per ton.

There are some minute practical considerations in the aggregate worth mentioning, which tend to confirm this conclusion: and should these reflections meet the eye of the engineers of the committee, they may be reminded of the difficulty of keeping canal gates tight; that sometimes floating substances will get between them, and greatly increase the loss of water. This may be of no great importance there, because it is a leak outwards; but the case is very much altered when it is inwards, and that into no very large space, and under the pressure of a head of ten feet of water.

Again:—What skill is not exerted by the profession, in building the most *substantial foundations and side supports, of the Gates of the Dry Dock!* No engineer can say, that it is possible to give the Floating Dock an equally substantial and perfect gate: and yet a Dry Dock presenting only a narrow front to the tide, and not having a bottom, and sides, full of seams, is, necessarily, pumped frequently, when a ship is under repair within it. But the most formidable cause of strain, and liability to get out of order, still remains to be mentioned. *It is the action of the ship.* She is, if possible, placed precisely in the centre; but, could a perfect equipoise be produced, it could not be maintained; it would be destroyed by the lightest breeze; the weight will unavoidably be greater on one side of the centre, than on the other; she will consequently tend to incline, as soon as she begins to lose the support of the water. It was this water that constituted her *stability.* She now begins, through the medium of her shores, to lean on one side of the dock: but the dock is nearly full of water, and can have no stability, unless it be derived from the ballast, and the trunks; it is on these, therefore,

that the inventor relies. But let us examine the operation a step further. The ship inclines, one trunk is depressed, the other rises; one resists the leaning of the ship, the other assists it. We may admit that the depressed side is not yet under water: but the more the dock is pumped out, and the more its consequent buoyancy increases, the more the ship will incline, not only by its whole weight, but by the *leverage* of the upper works, and of every thing aloft, in proportion to their distance from the head of the shores, which act *as fulcra;* and the more she leans, the more stress have the horizontal shores to bear. The question now is, whether the depressed *air tight trunk* will, by its buoyancy, right the ship, or be immersed by the joint action of the ballast, and the ship upon it. This is a calculation for engineers and nautical men to make, the *data being first known;* the weight of ballast, the weight of ship, the angle of inclination, the leverage power, and its increase, being placed on the one side; and the displacement of water by the *immersed trunk*, on the other; would determine, with some probability of precision, (the wind not blowing,) how large the trunk should be.

It is this, which the recommended experiment, is, we may presume, intended to decide. There was certainly talent enough in the committee to have balanced these forces, and to have computed every possible contingency, without subjecting the merchants to the loss of even "three thousand dollars."

If the action, and reaction, we have described, should cause the floating dock to leak, the committee say, that "the repairs of this structure can be effected with despatch and economy—if the bottom requires inspection, the dock can be hauled up on a common building slip, and examined." With great deference to the committee, I confess, that I more than doubt the *despatch and economy* of this operation. If so easy a thing to do, why are vessels generally *hove down*, under all the disadvantages, and with so much detriment, as the committee justly describes?* In fact, it is a very different thing to launch a ship and haul her back again. *Facilis descensus Averni:—Sed revocare gradum,—Hoc opus hic labor est.*

I am aware of the difference in the form of the bottom, but whether flat or curved, there must be bilge ways applied. To the bottom of a ship, as narrower than the dock, they may be supposed to give a better support. Compared with the width of the dock, the "common building slip," (if by this they mean the launching ways,) is very narrow. If, however, by it is meant the slope of ground, or place where building is done, then the preparations for the supposed operation, cannot be very economical. Besides, if the cables, or chains, are made fast to the dock itself, it will be a question whether the dock will be hauled up, or pulled to pieces.

From attentively considering the subject, I cannot help coming to the conclusion, that a floating dock of 500 tons, will cost, at least, 25 dollars per ton, which will amount to 12,500 dollars. The pumps, the power, the cables, moorings, &c. we may conjecture, will cost

* See pages 3 and 4 of this volume.

3,000 dollars, and the locality, probably 10,000 dollars. I do not say, that even this is too much, should it answer the purpose, but it is considerably more than the report contemplates.

A SHIPWRIGHT.

Philad. Jan. 20th, 1827.

Specification of certain Improvements on the Balance Lock, or Inclined Plane, intended as a Substitute for Locks on Canals, especially on such Canals as have a great lift, together with a scarcity of water. Invented by MINUS WARD, *Civil Engineer.*

In order, the better to illustrate the utility of the invention, we will first describe the whole machine, and afterwards point out those particular parts which are new and peculiar. The two sections then of the canal, which are upon different levels, are to be brought, the one to the foot, and the other to the top, of that declivity of the ground which may present itself as most favourable for the site of the works. The lower section of the canal terminates at the foot of the declivity in form of a basin of a sufficient area and depth, for the purpose intended. The upper section of the canal, branches off, a small distance above the works, into two branches, which branches terminate in open mouths, constructed with two side walls and a flooring of hewn stone each; they terminate abruptly, at right angles to their length, and are so situated as to stand with their mouths pointing directly towards each other; the upper side walls, of each, or those next the hill, being in the same straight line, and the lower walls of each, are in a like situation with respect to each other. These mouths are but a few inches wider than the width of one of the boats intended to be navigated upon the canal, and of a depth no greater than is sufficient to float a boat, when loaded. The distance between these two mouths, exceeds, by a few inches, the aggregate length, of the two moveable receptacles, in which the boats are contained during their ascent and descent; which receptacles, we will call the *cradles*, and of which, a more particular description will be given further on. But to return to the mouths belonging to the upper canal; each of these mouths is furnished with a *sliding mouth piece*, constructed of sheet iron, one-fourth of an inch in thickness, rivetted together in the manner of steam engine boilers, with their bottoms horizontal, and sides vertical, with both their ends open, excepting when those towards each other are occasionally closed with gates; these mouth pieces we will hereafter call the *connectors:* they lack two inches on each side, of being as wide as the stone mouths, in which they work; they need not exceed three feet in length each, in the direction parallel to the walls, and to their own motion; they are supported at the ends towards each other, by a ledge of wood, extending across, and being made fast to the bottom of the stone mouth; two other pieces extend up, one on each side, to the top of the walls, so

as to fill the space between the outsides of the connector, and the insides of the stone mouths. In like manner the other ends are supported by similar ledges of wood, except that each is furnished with two of those ledges, placed three inches apart; the three inch groove thus formed between the ledges, is filled with oiled hemp, so that the sliding mouth piece can move backward and forward upon the hemp, in a direction parallel with the walls, and yet no water can pass between the sliding mouth pieces, and the stationary stone mouths. Each of these connectors is furnished with a pair of gates, also of sheet iron, hung upon the ends of the connectors towards each other, by hinges on each side, and meeting together in a straight line when closed in the centre of the breadth of the sliding-mouth-piece, each pair of gates, opening into the cavity between the walls; their bottoms resting against a flaunch of three inches in breadth, formed by turning in the edge of the connector; they rest also at their sides, against similar flaunches, up the sides. The tops of these gates, in order to save room, are furnished with a bar, or brace of iron, extending across the top of the gates, nearly to the hinge side of each; this brace is supported, however, by only one horizontal screw bolt, in the wing of one of the gates, so that it can be turned up in a vertical position, at the time of opening and shutting the gates. These connectors have each a rack, made fast to the under side of their bottoms, with a shaft extending across, under each, and a pinion made fast to each shaft, working into the racks. Those shafts project out on the upper side, beyond the outsides of the walls, with a ratchet wheel, six feet diameter on the outer end of each shaft, and a click to hold both ways, so that with regard to this ratchet wheel, its shaft, pinion, and the rack in which it works, as also the motion, or effect produced, is precisely the same, as it is in the well known contrivance, for the carriage of a saw-mill, except that the clicks are made to hold in either direction, as the case may require. The ends of these connectors toward each other, extend a few inches beyond the terminations or ends of the stone mouths. We have already stated, that each connector is furnished with a flaunch, for the gates to shut against, but those flaunches, serve another, and a very remarkable purpose, and upon which, the facility and despatch of passing a boat, in a great measure depend. The faces of these flaunches, toward each other, are armed with about a dozen thicknesses of canvass.

The two cradles are constructed also of thick sheet iron, each of a capacity sufficient to contain the boat; each of them is furnished with a separate chamber under its bottom, of a capacity to hold a quantity of water sufficient, so that when one of the cradles has this inferior chamber filled with water, and the other cradle, at the same time, having its inferior chamber empty, a preponderating force is obtained sufficient to give the requisite velocity to the cradles. These cradles are mounted upon cast iron wheels, and move up and down, side foremost, upon cast iron rail-ways, placed in an inclined position, to suit the inclination of the ground, not being confined to any particular inclination or height. The cradles are so situated, as to pass each other, leaving a few inches between their ends, at the time of passing.

Their ends towards each other, are closed, the other ends are furnished each with flaunches, and a pair of gates, exactly similar to those already described. The gates open into the cavity of the cradles. The bottoms of the inferior chambers are constructed so as to incline to the horizon in an angle nearly equal to the angle of the rails, and in the same direction, forming an acute angle with the lower side of the cradles; this will cause the cradles to enter the water in manner of a wedge, causing little or no collision. A strong frame work of timber covered with a shed, is placed upon the brow of the declivity, at the upper end of the rail-ways, in which are supported six drums of cast iron, furnished with fly wheels of the same metal; from three of these drums, a like number of chains extend to the ends, and middle, of one of the cradles; and from the other three drums, chains extend in like manner, to the other cradle; connecting chains extend also, from one set of drums to the other, so that one cradle cannot descend without causing the other to ascend; or, perhaps, instead of placing the drums vertical, and using connecting chains, a better modification would be, to place all the drums on one horizontal shaft, extending the whole length, across the top of the rails; this shaft should be cast hollow, of a diameter and thickness of metal sufficient to ensure it from twisting off, with a gudgeon at each end, and supported in a sufficient number of places along the shaft, by resting on the circumferences of other wheels, generally termed friction wheels; the chain from one cradle, to one set of drums, wind on to the drums by the under side, and those from the other cradle, wind on by the upper side of the other set of drums, with but one fly wheel in the middle of the shaft. These chains are of such a length, that when one cradle is in a line with its corresponding connector, the other is immersed in the water of the basin below, so that its upper edge shall be level with the surface of the water. The inclined railways extend down into the basin deeper than the cradles are intended to descend, and there are six of them, three for each cradle. The fly wheels are furnished with brakes: these consist of a strap of iron extending round the wheel, for about three-fourths of its circumference, and furnished at one end with a lever, to give the necessary purchase; the other end is made fast to a stationary stud. When the lever is pressed upon with the hand, the strap binds hard upon the extreme surface of the fly wheel, thereby causing great friction, at other times it does not touch the wheel. Each cradle is furnished with a strong pall, in the middle of its length, to stop it in a line with the connector, while the boats are floated in and out, the brakes are also drawn at the same time hard down upon the fly wheels, and hooked, and assist very much in holding the cradles. The operation is as follows. Suppose one of the cradles, to be held by its pall, assisted by the brakes; the keeper goes to the ratchet wheel of the connector, corresponding to this cradle, throws out the click, which holds the connector back, and applies his foot upon the pins, in the side of the ratchet wheel, for that purpose, and turns it round; this forces out the connector, and brings its armed flaunch directly in contact with the corresponding flaunch upon the cradle,

and presses them together with sufficient force to make the joining water tight, when they are held in this position by the click; then by drawing a small wicket gate, in one of the gates belonging to the connector, the water of the upper section rushes in and instantly fills the small space between the two pair of gates, when these last may be opened with ease, for the pressure is now equal on every side. A boat wishing to descend, may now pass directly into this cradle, for it has in this position, become a part, and extension of the upper section of the canal; but as the other cradle is, at this period, immersed up to its top, in the basin below, a boat wishing to ascend may open the gates, (for the pressure is equal on each side of these gates) and pass into this cradle, and close the gates behind her; but before it can ascend, the boatman must draw a gate, which will suffer the water to run out of the inferior chamber of his cradle; this it cannot do, until the cradle is suffered to rise, because the chamber is entirely under water; but by this time, the keeper has closed the two pair of gates above, thrown out the click, which held the connector pressed against the upper cradle, drawn back the connector far enough to clear it from the cradle, say two inches, the small quantity of water which was contained, between the two pair of gates, drops down and runs along a gutter into the basin—then, by first letting go the pall, and next unhooking the lever of the brakes, this cradle (having had its inferior chamber filled with water, previous to the closing of the gates, by drawing a horizontal valve in the bottom of the superior chamber of the cradle,) will preponderate, and raise the other, so as to bring the surface of the water in its inferior chamber, above the surface of the water in the basin, when the water contained in the chamber commences, and continues to run out, as the cradle rises, until it is all discharged; the other cradle is suffered to come down with an accelerated motion, the velocity of which descent must be so regulated, by the quantity of water which has been suffered to run into the inferior chamber, as to cause the fly wheels to perform a peculiar office assigned them, which is this: when the descending cradle has reached the surface of the water in the basin, and its submersion commenced, the buoyancy of the water contained in the basin, gradually takes off, and finally destroys its preponderating force, and an equilibrium will be attained, at a point somewhere between the commencement and the termination of the submersion of the cradle; that is, if the cradles were suffered to come to an equilibrium, the upper cradle would be found, by reason of the buoyancy of the water in the basin acting upon the other cradle, to be something below its corresponding connector.

The requisite accelerated motion spoken of, and the effect to be produced by the vis inertiæ of the fly wheels, is to carry the ascending cradle something higher than the connector, where it is caught by the brakes, and suffered to return gently upon the pall: but it would not return upon the pall with an injurious velocity, if no friction was applied; because the lower cradle having become surrounded with water, can move side foremost through it, with but a slow motion, beginning as it does from a state of rest, and not passing over more than from 12 to 18 inches. The keeper, then, by going through the

same operation with this side of the machine, forms, by means of the ratchet wheel and connector, the connection between this cradle and this branch of the canal; the wicket or small gate is drawn, the two pair of gates are opened, and the boat which has thus ascended, is at liberty to depart on her way, and another ready to descend, may take her place in this cradle, and close the gates behind her, when the communication may be cut off by drawing back the connector, as it was on the other side; in the mean time, the boat which has descended, having now the top of her cradle upon a level with the surface of the water in the basin, is at liberty to open the gates of this cradle, and to depart; another, wishing to ascend, may now take her place, and close the gates behind her. One half of the apparatus, being an exact counterpart of the other, the ascent of this cradle, and the descent of the other, is but a repetition of the process already described, this half of the apparatus performing now, what was before performed by the other, and so on alternately. But, it is evident by this arrangement, that we can, not only thus ascend with one boat, and at the same time descend with another, but that a boat may ascend without the necessity of waiting for another to arrive to descend at the same time; and vice versa; because the superior chambers being always full of water, the entrance of the boat by displacing its own weight of water, causes no addition to the weight of the cradles.

The points of difference between this balance lock, and others which have been proposed, some of which are in operation, appear to be first, and principally, in the facility and despatch, which by means of the sliding-mouth-pieces, we are enabled to form, and to cut off at pleasure, the communication between the cradles and the upper section of the canal; 2d, in the use of the vis inertiæ of the fly wheels, in carrying the cradles beyond the point of equilibrium, thereby avoiding the necessity of a set of mouths at the lower end of the inclined rails like to those above, which would otherwise be necessary. And 3d, in the manner of hanging the gates, and of bracing them across their tops by the revolving bar.

FOR THE FRANKLIN JOURNAL.

A further description of Ward's Balance Lock.

MR. EDITOR,

The accompanying printed description of "The Balance Lock," &c. was written in the year 1824, and published in the Baltimore American, of the 15th. Dec. 1824.

On mature reflection I deem it adviseable to give a general outline of the principal features of the machine; and I also add, a further description of that most essential part of the invention, "*The Connectors.*"

1st. The cradles of this machine move up and down upon the inclined railway, *side foremost*, as proposed by Robert Fulton. [Vide

Repertory of Arts, vol. 7. page 222.]—This enables us to lay the rails with an elevation of about 30 degress to the horizon, which saves a considerable proportion of the expense, by shortening their length, and enables us to give the cradles a much greater velocity; they being allowed to run on, until they stop spontaneously; no solid body being interposed in the line of their motion, which is the case if we attempt to move the cradles end foremost.

2d. The preponderating power is obtained by filling with water, and emptying, as occasion may require, an extra chamber, attached to the cradles, as proposed by Leach, an English Engineer. [Vide Rees's Encyclopædia.]

3d. The ascending cradle is carried above the point of equilibrium, and also above its corresponding mouth of the canal, by means of the vis inertia of a large fly wheel, attached to the horizontal shaft, upon which the chains from the cradles are coiled, without the necessity of introducing cog wheels, which would be expensive, making the machine complicated, and even dangerous. The vis inertia of the fly wheel, causes the machine to overrun the point of equilibrium, and as it returns again, upon the principle of common vibrating bodies, being still urged toward the point of equilibrium, it is arrested at the proper time and place, by the pall. This I claim as my invention, and believe it to be better entitled to the character of "boldness"* than are other plans which have lately been published.

4th. The method of *forming*, and *cutting off*, the communication between the cradles, and their corresponding mouths of the canal above, by means of *sliding connectors*, moving, water tight, through a packing of oiled hemp, I also claim as my invention. This part of the machine, completely removes the difficulty heretofore existing, in forming a water tight connexion between the cradle and the upper section of the canal, a difficulty foreseen by the able committee of the Franklin Institute, who reported on Professor Renwick's inclined plane.

In the description of my inclined plane, published in the Baltimore American, I proposed to use two, or more, chains; this idea, therefore, was not new, when Professor Renwick published his views upon this subject.

5th. The method of hanging the gates, to form a straight line across the cradle, and the method of supporting them by means of the revolving bar at the top, I also claim as my invention.

After further consideration of my *connectors*, I propose to have three racks to each *connector*, with a pinion, shaft, ratchet wheel, and click, to each rack; entirely separate and distinct from each other: viz.—One under the centre of the *connector*, as proposed in my description, dated 1824, and one on each side at the top edge of the *connector*. The rack bar, of the rack below, must be fixed to the bottom of the *connector*, by a single bolt, and allowed to turn freely on said bolt. The *connector* should also be made short, in the direc-

* Vide Report on Professor Renwick's inclined plane, &c.

tion of its motion, say only 12 inches. By this arrangement, if one end of the cradle should gain upon the other end, in winding up, so as to make a difference of an inch or two at the parts of contact, between it and the cradle, when you come to force the *connector* out against the cradle, if one end of the *connector* touch the cradle, first, it is free to turn upon the bolt in the centre, and allow the other side to come up also. The complete contact of the two surfaces, is further facilitated by the two racks above.

A model which I had made in 1824 was seen in operation in this city, by Robert Smith, Esq. former Secretary of State, U. S.; J. L. Sullivan, Civil Engineer; Capt. Poussin, Top. Engineer, U. S.; Lieut. Sherbourn, Hydrographer, U. S. N.

By inserting the above remarks, together with the accompanying printed description, in your useful Journal, you will much oblige,

Yours, &c.

MINUS WARD.

Baltimore, January 11th, 1827.

FRANKLIN INSTITUTE.

At a Meeting of the Franklin Institute, held at their Hall on the 18th day of January, 1827, JAMES RONALDSON, President, in the Chair; THOMAS P. JONES was appointed Secretary.

The Managers presented their twelfth Quarterly Report, which was read and adopted.

The Treasurer presented the third Annual Report of the state of the funds, which was read and adopted.

On motion, Resolved, That the thanks of the Institute be presented to the Treasurer, John Richardson, for the able and faithful manner in which he has performed the duties of his office.

The tellers, who had been appointed by the board of Managers to hold the Annual Election of Officers for the year 1827, reported the following as duly elected.

Officers for the year 1827.

PRESIDENT—James Ronaldson.
VICE-PRESIDENTS—Mathew Carey, Paul Beck.
RECORDING SECRETARY—Thomas P. Jones.
CORRESPONDING SECRETARY—Peter A. Browne.
TREASURER—John Richardson.

MANAGERS.

Thomas Fletcher	Rufus Tyler
John Harrison	James J. Rush
S. V. Merrick	H. J. Riehle
Daniel Groves	Clement C. Biddle
Abraham Miller	John Struthers
Adam Ramage	John O'Neil
Harvey Lewis	Robert E. Griffith

R. M. Patterson
James M'Alpin
Isaac B. Garrigues
William S. Warder
A. G. Ralston
M. W. Baldwin
W. S. Hansell
Joseph H. Schreiner
S. J. Robbins
Joseph Beale

(Adjourned.)

JAMES RONALDSON, *President.*

THOMAS P. JONES, *Secretary.*

Abstract of the Twelfth Quarterly, or Third Annual Report of the Board of Managers.

The Board state that the regular courses of lectures on Mechanics, and on Chemistry, had been resumed, and regularly continued; that Mr. Raffinesque had given several lectures on Natural History, and that volunteer lectures had been occasionally given by others.

The Mathematical school has been abandoned by Mr. Espy, in consequence of the slender encouragement received; but the Drawing school continues to flourish, there having been fifty-five scholars, during the first quarter.

The High School is in complete operation, with its full complement of scholars, 304; of these, 300 study the English Language, 153 the French, 105 the Latin, 35 the Greek, 45 the Spanish, and 20 the German; 300 Elocution, 240 Geography, 231 Linear Drawing, and all, Arithmetic, or some other branch of the Mathematics. The Board state that no public examination having yet been had, they cannot speak definitively respecting its real merits, but think it calculated to do much good, and that it ought to be cherished.

The Board recommend to their successors, to adopt effectual measures for the display of the Models, Minerals and Books, belonging to the Institute; this object having been neglected, in consequence of the appropriation of the third story of the Hall, to the use of the High School.

Many interesting and valuable inventions have been referred to the Committee of Inventions, and several of the reports upon them have been published in the Franklin Journal.

The Hall of the Institute has been completed, and the Building Committee were on the eve of a final settlement with the contractor.

Two hundred and twenty new members have been elected during the year. The Treasurer's Report presented a balance of $743 43 in his hands.

COMMITTEE OF INVENTIONS.

Report on the "Radiating Rail-ways, for the repair of Vessels." Invented by EDWARD CLARK, *Civil Engineer, New York.*

[WITH A PLATE.]

The Committee of Inventions, to whom have been submitted, a Model, Drawings, and Description of the "*Radiating Rail-ways for the repair of Vessels,*" invented by EDWARD CLARK, of New York, Civil Engineer, Report, That they have carefully examined the proposed improvement, and consider the plan as offering great facilities, when it is desirable to have several vessels under repair, upon the ways, at the same time. Morton's Patent Slip, which is in use in Scotland, is of sufficient length to contain two or three vessels; but it is evident that whichever was the last hauled up, must be the first launched, and they must, therefore, be frequently repaired in haste, without being allowed that time to dry, which is, in many cases, a point of great importance: to obviate this difficulty, is the end proposed in the plan now under consideration.

It does not appear, from any thing which has been presented to the Committee, that Mr. Clark proposes any thing novel in the construction of the lower part of the rail-way or of the carriage upon which the vessel is to be drawn up; its distinguishing feature being the means provided for removing vessels out of the direct line of the main rail-way, and of depositing them upon *sub-ways*, for the purpose of being repaired. To accomplish this purpose, the upper part of the rail-way, for a length sufficient to receive a vessel, is detached from the lower part, and is made capable of revolving upon a firm, horizontal platform, a perpendicular shaft from which, passes through the upper end of the detached part of the rail-way. This platform is the segment of a circle, but it may, if necessary, present a complete circle. At the periphery of this segment, the fixed part of the rail-way terminates, and the detached revolving part commences; this is supported upon the platform, by a sufficient number of strong iron rollers, placed transversely on the lower part of the frame work, of which it is formed. The upright shaft, around which the detached rail-way is capable of revolving, is also the shaft of the windlass, by which the vessels are to be drawn up; this detached way, may therefore be considered as a radius to the circle, of which the platform is a segment.

When a ship is drawn up, and has arrived upon the moveable part of the rail-way, a power may be applied to carry this, with its load, to the requisite distance round the circular platform, until it arrives at a *sub-way*, several of which are erected around the platform, forming produced radii to the circle. These are precisely similar to the main rail-way, with the exception of their not being continued to the water, but only of such a length as to admit of the carriage, with its load, being lowered, and deposited upon them, until the intended repairs are made. In the drawing which accompanies this report, there are represented six sub-ways, and of course, upon such a structure, seven vessels might be placed at one time.

The main expense attending the erection of marine rail-ways,

is in constructing that part which is under the water, where nearly the whole of the labour must be performed in the diving bell; in the mode proposed by Mr. Clark, one principal way would be sufficient in those ports where many vessels may require to be hauled up; a considerable number of *sub-ways*, with their appurtenances, might, undoubtedly be provided, at an expense far below that which would attend the original structure. After maturely considering the subject, the committee are fully convinced of the practicability of the plan, and also of its economy, in those situations where more than a single rail-way would be desirable. When once constructed, it possesses the advantage of being capable of extension in the number of its *sub-ways*, whenever it may be required.

ROBERT M. PATTERSON, *Chairman.*

THOMAS P. JONES, *Secretary.*

Philadelphia, January 15th, 1827.

Description of the Plate of Clark's Radiating Rail-ways.

Fig. 1.—Bird's-eye view of the platform, and rail-ways.

A, Revolving section of the rail-way, which may, at pleasure, be made to coincide, and connect with,

BBBB, The radiating or *sub-ways*, or with

C, The main rail-way, extending into the water.

D, The shaft, or pivot, upon which the section A revolves.

Fig. 2.—Represents the revolving section, with its centre, as in fig. 1, together with the circular iron rail-ways, upon which the cast iron rollers are to run.

Fig. 3.—Elevation, or side view, of the revolving and permanent rail-ways, supporting a ship's carriage.

A, The revolving section.

B or C, Section of the main, or of the sub-rail-ways.

D, Shaft for communicating to the windlass the power which is generated at the levers *d*. This shaft is also the pivot around which the section A is made to revolve.

eeee, &c. Iron rollers, connected to, and supporting the revolving section, on the circular rail-ways.

G, Ship's carriage, resting on the inclined rail-ways.

H, Windlass, or other machinery for elevating vessels.

i, Chain by which the carriage is drawn up.

k, Palls, to prevent the carriage from running back.

l, Friction rollers, flying between the moveable and fixed ways.

Fig. 4.—Ground view of a ship's carriage.

Fig. 5.—Transverse view of a ship's carriage, on rail-ways.

aa, Cuneiform blocks, moveable on rollers, in appropriate grooves, to prevent lateral motion.

bb, Bilge-blocks, moving on pivots, and resting on rollers adapted to *aa*.

cc, Ropes, by which the cuneiform, or wedge-blocks, are drawn up, and the bilge-blocks forced against, and adapted to, the bottoms of vessels.

COMMITTEE OF INVENTIONS.

Report on a Method for raising and lowering Canal Boats, with little loss of water; proposed by David Townsend.

The Committee of Inventions, to whose examination has been submitted a method for raising, or lowering, Canal Boats, without loss of water, invented by *David Townsend* of Big Beaver Falls, Pennsylvania,—

Report, That the shortness of the time allowed for an examination of the Model, in consequence of the departure of the inventor from the city, did not admit of drawings being procured; and without these it would not be possible to give a clear description of the apparatus employed; the committee, however, were highly gratified by the ingenuity which it manifested; and they will, therefore, give a general idea of the principle, upon which its action depends.

It is known to those who are conversant with the progress of canal navigation, that what has been denominated *plungers*, have been proposed for the purpose of forcing up the water in the chamber of a canal. The use of this has been adopted by Mr. Townsend in his Model, and he has contrived a very ingenious method of balancing, raising, and lowering it.

The *Plunger* is a heavy caisson, or a solid block, made of the length and width, nearly, of a canal chamber, and when adopted in practice, the chamber must be of double the ordinary width; the plunger occupying one half, and the boat to be raised, the other. When a boat from the lower canal, has entered the chamber, and the gates are closed, the plunger is made to sink perpendicularly into the water over which it is suspended, on one side of the chamber: this will, of course, cause the water to rise, and should the horizontal section of the plunger be equal to half that of the chamber, the water will rise as many feet as the plunger is immersed. A boat may be thus raised to the height of the ordinary lift of a lock, and that with no further loss of water than the unavoidable leakage of the gates.

The committee do not recollect any instance in which this plan has been adopted in practice; they, however, are of opinion that it merits more attention than it has received. They have already adverted to former proposals for the employment of the plunger; and in this particular, therefore, the invention of Mr. Townsend has no claim to novelty. Under the article *Canal* in Rees's Cyclopædia, it is mentioned that Mr. *Lawson Huddleston* had proposed a similar plan, and had contrived a counter weight, which, by its action on a snail, or spiral curve, balanced the plunger, in all its different degrees of immersion. Mr. *Robert Salmon*, also proposed to accomplish the same end, by sinking a hollow plunger, in another way; and received from the *Society of Arts*, a premium for his invention; and others have, subsequently, made similar propositions. The committee do not suppose that Mr. Townsend was acquainted with these facts, but they are not in the possession of the particulars of his claim. His mode of balancing the plunger, they believe to be new, as it differs materially from either of the plans to which they have adverted. It

has already been stated, that the particulars of this plan, cannot be described in words alone; we will therefore only state, that a strong, moveable platform, is elevated above the plunger; upon this platform weights are placed, which can be made to act upon the plunger, and cause it to be submersed its whole depth; these weights then act upon levers, which are in such a position as to exert a maximum force. When the plunger begins to rise from the water, these levers change their positions in such a way as to lessen their action, and that, in exact proportion to the decreased force of the water; and when the plunger is raised, so as to receive no support from the water, the weights retain it in this position. The committee have not thought it necessary to institute a comparison between the various plans to which they have alluded; nor would they be able so to, did they deem it desirable, as the cursory examination of the model in question, has not placed the means within their power.

By order,

THOMAS P. JONES, *Secretary*.

Philadelphia, January 15th, 1827.

FOR THE FRANKLIN JOURNAL.

MECHANICAL JURISPRUDENCE.—No. XIII.

BY PETER A. BROWNE, Esq.

On the law of Patents for new and useful Inventions.

That acceptation of the word "manufactures" by which is intended the *method* or *manner* of making a thing, was considered in the last essay, (p. 14) and I shall now call the attention of the reader to its second meaning, which is, the *things* worked, or made. Under this head are included, 1st, new compositions of things. 2nd, All mechanical inventions.

New compositions of things, are *manufactures*, in the most common, and ordinary sense of the word; thus we say the manufacture of cloth, glass, &c. Every *mechanical invention*, or machine, is a manufacture, and is patentable, whether it be an *old* machine, or engine, which will produce a *new* and useful effect; or a *new* machine, or engine, which will produce an *old* and useful effect.

I shall not pretend to define the word machine, or engine; as an attempt to define words which are so plain, familiar, and intelligible, leads to unnecessary difficulty. We have a powerful instance of this in the cases referred to, in the last essay; where the words principle, method, engine, &c. words which are perfectly well understood, have two or three meanings assigned them, and are thus rendered obscure, if not unintelligible.

The word *manufacture*, is found in the Act of Congress, with three other words; namely, art, machine, and composition of matter. These words, without any torturing, will be found to include every invention patentable by the English law.

This is also the most proper place to remark, that the third section of the act of Congress, to the word inventor, found in the British statute, adds that of *discoverer* of any art, machine, &c. and the second section does not limit the author to the "working or making," as in England, but provides for the "*making, constructing, using,* and *vending* to others to be used, the *invention* or *discovery.*"

A patent may be taken for an *improvement* or *addition.*

In England, it was formerly held, that a patent could not be for an *improvement* or addition. Lord Coke in 3d institutes, 184, says, "but if the substance was in esse before, and a new addition thereunto, though that addition make the former more profitable, yet it is not a new manufacture in law." He relies on Bircott's case, in the Exchequer Chamber, in the 15th year of Elizabeth. This case was decided before the passing of the statute of James.

Morris v. Branson, was tried in 1776; it was respecting a patent for making oilet holes, or net work, in silk, thread, cotton, or worsted; and the defendant objected that it was not a new invention, it being only an addition to the old stocking frame. Lord Mansfield, after one of the former trials on this patent, said, "I have received a very sensible letter from one of the gentlemen who was upon the jury, on the subject, whether on principles of public policy, there can be a patent for an addition only. I paid great attention to it, and mentioned it to all the judges. If the general point of law, viz. that there can be no patent for an addition, be with the defendant, that is open upon the record, and he may move in arrest of judgment. But that objection would go to repeal almost every patent that ever was granted."

There was in this case, a verdict for the plantiffs, with £500 damages, and no motion was made in arrest of judgment. Though his lordship did not mention what were the opinions of the judges, or give any direct opinion himself, yet we may safely collect, that he thought, on great consideration, the patent was good, and the defendants' counsel, though they had made the objection at the trial, did not afterwards persist in it.

Bircott's case is thus noticed by Buller, J. in 2 Henry Blackstone's Reports, 488, "That a patent for an addition, or improvement, may be maintained, is a point which has never been directly decided; and Bircott's case, 3 Inst. 184, is an express authority against it. What were the particular facts of that case, we are not informed, and there seems to me to be more quaintness, than solidity, in the reason assigned; which is, that it was to put a new button to an old coat, and it is much easier to add than to invent. If the button were new I do not feel the weight of the objection, that the coat on which the button was put, was old. But in truth, arts and sciences, at that period, were at so low an ebb, in comparison with that point to which they have been since advanced, and the effect and utility of improvements so little known, that I do not think that case ought to preclude the question. In later times, whenever the point has arisen, the inclination of the Court has been in favour of the patent for the improvement, and the parties have acquiesced, where the objection might have been brought directly before the court." He then cites Morris

v. Branson, as above stated, after which he proceeds—"Since that time (1776) it has been the generally received opinion in Westminster Hall, that a patent for an addition is good."

Lord C. J. Eyre, speaking of Bircott's case, says, "The principle on which that case was determined, has been, as my brother Buller observes, not adhered to, viz. that an addition to a manufacture cannot be the subject of a patent."

In Hornblower v. Boulton, 1799, Grose, J. remarks—"But a doubt is entertained, whether there can be a patent for an *addition* to an old manufacture; this doubt rests altogether upon Bircott's case, 3 Inst. 184, and if that were to be considered as law at this day, it would set aside many patents for very ingenious inventions, in cases where the additions to manufactures before existing, are much more valuable than the original manufactures themselves. I shall content myself with referring to what Lord Chief Justice Eyre said in this cause, in the Court of Common Pleas, in answer to this, and to the case of Morris v. Branson, cited by my brother Buller upon the same point. If, indeed, a patent could not be granted for an addition, it would be depriving the public of one of the best benefits of the statute of James." Lord Coke's opinion, therefore, seems to have been formed without due consideration, and modern experience shows that it is not well founded.

A patent had been granted in the 27th year of King George III, for a machine for the manufacture of woolen cloths. In the 34th George III, another patent was granted for *improvements* upon that machine. Upon a motion to dissolve an injunction, obtained by the patentee, an objection was taken to the specification under the latter patent, as describing the machine with the improvements, as one entire machine, the subject of that patent; not distinguishing the original machine, from the improvements. The answer admitted, that the improvements were new, substantial, and a greater saving of power; and that the description in the specification of the machine with the improvements, was accurate, and intelligible; so that the machine could be made according to that description. The Lord Chancellor, in delivering his opinion, says, "I do not enter into the question, whether a patent for improvements can be supported. *The affirmative has long been settled, and undoubtedly is the law.*" 14th Vezey's Reports, 133, Harmer v. Plane.

The case of Fox, ex parte, in Vezey & Beame's Reports, 67, was a patent issued *by order of the lord Chancellor*, for certain *improvements* in steam engines.

I rather think, therefore, that no risk is incurred by laying down the English law to be, that a patent for an improvement, or addition, is valid.

The case of an improvement, is expressly provided for by the American Law. The 1st section of the act of Congress of 1793, enacts, "That when any person or persons, being a citizen or citizens of the United States, shall allege, that he or they have invented any new and useful art, machine, manufacture, or composition of matter, or any new and useful *improvement* on any art, machine,

manufacture, or composition of matter, not known or used before the application; and shall present a petition to the Secretary of State, signifying a desire of obtaining an exclusive property in the same, and praying that a patent may be granted therefor, it shall and may be lawful for the said Secretary of State, to cause letters patent to be made out," &c.

But the patent is valid only for the improvement, and gives the patentee no title to use the original invention.—This was laid down by Buller in the case of Boulton & Watt v. Bull, formerly quoted; where, to what was before noticed, he adds the following observation. "But then it (the patent) must be for the *addition only*, and not for the old machine too."

Jessop invented a watch movement, and he took out a patent for the whole watch, and his patent was avoided. Cited by Buller, J. in Boulton & Watt v. Bull. So in the case of Harmer v. Plane above mentioned, the Lord Chancellor, after stating, that it had long been settled that *improvements* were patentable, and that the second patent would subsist till 1808, says, "but the original instrument without the improvements, was open to the public in 1801."—14th Vez. 133.

This also is expressly provided for by the act of Congress, section 2d. "Provided always, and be it further enacted, that any person, who shall have discovered an improvement in the principle of any machine, or in the process of any composition of matter, which shall have been patented, and shall have obtained a patent for such improvement, he shall not be at liberty to make, use, or vend the original discovery, nor shall the first inventor be at liberty to use the improvement."

The patent must not be broader than the invention, or it is void.—Conformably hereto, the law was adjudged by Judge Story, in the case of Whittemore v. Cuttee, 1 Gallison's Reports, 478. "If the plaintiff, Amos Whittemore, be not the inventor of the whole machine, but only of an improvement thereof, his patent is too broad, and is utterly void; for it is clearly a patent for the whole machine."

And in like manner in Woodstock v. Parker, 1 Gallison's Reports, 438. Story, J. observes, "If the machine for which the plaintiff obtained a patent, substantially existed before, and the plaintiff made an improvement only, therein, he is entitled to a patent for such improvement only, and not for the whole machine: and under such circumstances, as this present patent is admitted to comprehend the whole machine, it is too broad, and therefore void."

As to what shall constitute an improvement, the same section declares, "that simply changing the form, or the proportions, of any machine, or composition of matter, in any degree, shall not be deemed a discovery."

So in Woodstock v. Parker, 1 Gallison's Reports, 438, Judge Story observes, "It is not necessary to defeat the plaintiff's patent that a machine should have previously existed *in every respect similar to his own*, for a mere change of *form*, or *proportions*, will not entitle a party to a patent."

So in Pettibone v. Derringer MS. Rep. C. C. U. S. one of the

questions submitted by Judge Washington to the jury, was, whether the twisted auger, of which the plaintiff claimed to be the inventor, was an improvement in the principle, or merely a change in the form and proportions; in which latter case, the patent was not good.

What constitutes the identity, or diversity, of two machines, so as to give, or take away, the right to a patent, is a question of fact, sometimes difficult of solution. To assist in its decision, Judge Story, in the case last cited, gives the following rules. "Where a specific machine already exists, producing certain effects, if a mere addition is made to such machine, to produce the same effects in a better manner, a patent cannot be taken for the whole machine, but for the improvement only." The case of a watch is a familiar instance. "The inventor of the patent lever, without doubt, added a very useful improvement to it; but his right to a patent could not be more extensive than his invention. The patent could not cover the whole machine as improved, but barely the actual improvement. The illustration might be drawn from the steam engine, so much improved by Messrs. Watt & Boulton. In like manner, if to an old machine, some new combinations be added, to produce new effects, the right to a patent is limited to the new combinations."

Where a patent is taken out for improvements in several different things, if there be defect in the title to any one improvement, the patent is wholly void.—This was decided in Brunton v. Hawkes, 4 Barnewall & Alderson's Reports, 544.--This was an action brought to recover damages for infringing the plaintiff's patent right to certain improvements in the construction, making, or manufacturing of, ships' anchors and windlasses, and chain cables or moorings. It appeared upon the trial, that so much of the plaintiff's improvement as related to the anchor, was not new. A verdict was found for the plaintiff; and afterwards, upon a motion for a new trial, the question was discussed, whether, there being no novelty in the mode of manufacturing the anchors, and the patent being granted for these three several things, if void as to one, was not void for the whole. Abbott, C. J. gave his sentiments as follows. "It is not without great reluctance that my mind has at length come to a conclusion, which (as far as my judgment goes) will have the effect of avoiding this patent. It appeared in evidence, at the trial, that the mode of making cables and anchors, introduced by the plaintiff into general use, was highly beneficial to his majesty's subjects; and I should wish that he, who introduced it, might be entitled to sustain the patent. Upon a full consideration of all the arguments that have been addressed to us, and a view of the patent, the specification, and the evidence given at the trial, I feel compelled to say, that I think so much of the plaintiff's invention, as respects the anchor, is not new; and that the whole patent is therefore void." And afterwards, "The question then is, whether, if a party applies for a patent, reciting that he has discovered improvements in *three* things, and obtains a patent for the three things, and in the result it turns out that there is no novelty in *one* of them, he can sustain his patent? It appears to me that the case of Hill v. Thompson, 2 Bayley Moore, 424, which un-

derwent great consideration in the Common Pleas, is decisive upon that question. The only difference between that case, and this, is, that here, the plaintiff, instead of saying that he has made certain improvements, *states the improvements;* but still he claims the merit of having invented improvements in all the three. The patent is granted upon the recital that he has made improvements in all the three, *and that they are new;* and the consideration of the patent is the improvement in the three articles, and *not in one;* for an improvement in only one of them, would render the patent bad. The consideration is the *entirety* of the improvement of the three; and if it turns out there is no novelty in one of the improvements, the consideration fails in the whole, and the patentee is not entitled to the benefit of that other part of his invention. For these reasons I am of opinion that the patent cannot be supported." Bayley and Best, Justices, were of the same opinion.

The question of identity, or diversity, of inventions, is a *mixed* question of *fact* and *law*. It is a question of fact to be proved by witnesses, who are to explain the precise agreements, and difference, between the given machines; and all the facts being given, it is a question of law, whether the principles are the same.

This rule is well elucidated by Judge Story in the case of Barrett v. Hall, in 1 Mason's Reports, 471—2. Where he says, "But, although the testimony of witnesses be admissible, to prove the identity, or diversity, of machines, in principle, yet, after all, it is but matter of opinion; and its weight must be judged of by all the other circumstances of the case. It is infinitely more satisfactory to ascertain, if we can, the precise differences and agreements; and when these can be subjected to the eyes, they almost supersede all the evidence of mere opinion. In all my experience, I can scarcely recollect a single instance, in which the general question, whether the principles of two machines were the same, or different, has not produced from different witnesses, equally credible, and equally intelligent, opposite answers. This could result only from the different meanings attached to the word, and from confounding its various senses. And this has been completely shown when the same witnesses came to explain the precise agreements and differences, in which they have almost uniformly agreed. The case now before the court is a perfect proof in point."

The witnesses differed as to the identity or diversity of the principles of the machines, but they all agreed in what were the precise differences and agreements, in fact. There seemed then nothing for the jury to decide.

FOR THE FRANKLIN JOURNAL.

Remarks on the coating of Iron with Copper.

LEBANON, JANUARY 22, 1827.

Mr. Editor.

SIR---Through the politeness of a friend, I have been gratified with the perusal of the Franklin Journal for January, 1827, in which I

find a notice of a patent obtained by Mr. David Gordon & William Bowser, Iron Manufacturers, London, for a method or process by which iron is coated with copper, and which is stated as a valuable discovery in the arts, &c. It may, probably, be a valuable discovery; but I am apprehensive, that there must be considerable difficulty attending the process, inasmuch as the iron has to be heated to a degree that will cause it to oxidize rapidly, unless entirely excluded from the air, which appears to me almost impracticable.

The following process I have been acquainted with for a number of years, and I think it much more simple, much more expeditious when any quantity of the article is required, much less expensive, and attended with much less risk; whilst it requires but little skill in the performance. Take a cistern of wood, of a size suitable for the articles required to be coated; fill it with rain, or river water; put up a small furnace; the best form, I think, is that used in rolling mills for heating iron, with anthracite coal, but it need not be more than one-third of the size. Any other kind of fire, that will produce a uniform heat, may answer; then take scraps of sheet copper, or any other copper most convenient, heat them to a bright red, sufficient to oxidize the surface, but not to melt the copper, then quench them in the cistern of water; continue to heat, and quench them, until more than a sufficient quantity of copper is oxidized and disengaged, to coat the articles required; stir the water well, and deposite the articles intended to be coated, in such a position that they will be entirely covered, and the water have free access to every part: leave them in this situation, from five to ten days, and they will be completely coated with copper. A kettle, for instance, made of sheet iron, and deposited in the solution, will become completely coated inside and out, and will appear as if made of sheet copper. The longer the articles remain in the solution, the thicker will be the coating, at least so far as my experience goes. If you should think the above worthy a place in your useful Journal, it is at your service; if not, dispose of it as you think proper. I am no patent-monger, neither do I intend to become one; they are already too numerous, their contrivances, in general, serving as proofs of idleness, rather than of genius.

Yours, &c.

JOSHUA MALIN.

P. S. I have lately invented a pyrometer, for measuring the contraction and expansion of metals, &c. it is very simple, and easily constructed, yet I think very accurate. I have not seen, or heard of any one upon a similar plan, and shall take the liberty of sending you a description of it, as soon as I have leisure.

J. M.

Remarks by the Editor.—If *blue vitriol,* (sulphate of copper) be dissolved in water, and a clean piece of iron or steel, such as a knife blade, be dipped into the solution, the iron, or steel, will become coated with copper; in this case a portion of the acid, by which the copper was

dissolved, combines with and dissolves a portion of the iron, whilst the disengaged copper, taking its place, is precipitated upon the surface of the remaining iron, which it completely coats. This coating, however, will neither be thick, or durable, and is very different from that proposed in the patent. In the process recommended by our correspondent, there is no acid employed, and consequently no salt of copper formed; in what way the copper, in the state of oxide, becomes reduced, and combines with the iron, we cannot perceive. We should apprehend, that the only action in the case alluded to, must result from the accidental presence of acid, and that in *pure* water, there would be no sensible action. Our correspondent appears to speak from his own experience, and in this, should there be no mistake, he offers a much better test than our theory; as theories are good only so far as they are suggested, and supported by experience. The communication omits to mention, the necessity of a *perfectly clean* surface of iron; without this, however, no coating can be expected. We should be glad to *see* an article covered with copper, by the foregoing process.

FOR THE FRANKLIN JOURNAL.

Observations on Mill Spindles, and on Brands.

BRANDYWINE, 1st MONTH 16th, 1827.

To the Editor.

ESTEEMED FRIEND,—In looking over the Franklin Journal, pages 370, 371, for Dec. 1826, I observed an article on Mill Spindles, with a draft of one, and some observations on its utility, and recommending some precautions that I consider unnecessary, and of small value. I have been a Miller for nearly 40 years, and for the last 16 of the time, I have made use of cast iron, extensively, in the Mills that I have been, and am now engaged in, for wheels, gudgeons, and spindles, as well as for *steps* for those spindles; all which are *cast* iron throughout; the cock-head, neck, and toe, being all of the same piece of metal, cast at the same time; all of which have worn, very well, for 16 years past; having given us very little trouble. Had I now a new mill to build, I should use the cast iron spindles, &c. in preference to any others. It has occasionally been necessary to introduce new steps, as they *bore* down faster than the toes wear, but this has occasioned us little trouble, as we have a pattern of wood provided, and several extra steps at hand, which we put under the spindle, rough as they come from the furnace, (except cleaning out the sand that had adhered to the iron in casting) adding a small quantity of *ground emery* and oil; in this state the spindles are permitted to run (without the stone) for an hour or two, when they are lifted up and the emery cleaned out, and oil put in the steps; they are then ready for work, in the usual way. Our *brands* are also of cast iron, and they have been found to answer our purpose very well for many years, changing them as they burn out; this is done

very readily, as we always have some to spare, they being prepared at the furnace with a wrought iron bar about 15 inches long, to which we weld the old handle, when we find it necessary to make use of a new brand. I need make no further observations, than that the steps of the spindles ought to be cast of the *hardest* iron: and in relation to the brands, that in casting, the end of the bar of wrought iron should be *split* in *four* parts for an inch, and opened a little, and the brand cast *upon that end*, to prevent their becoming loose, which they are likely to do without this precaution.

A cast iron brand costs about *half* as much, and will last about half the time, of one that is wrought, and *cut*. But there is, in various respects, a great advantage in having two brands instead of one.

J. Morton Poole.

ESSAYS ON MATHEMATICS.

By the late Mr. John Cross, *Teacher of Mathematics, Glasgow.*

No. II.

In every age and country where learning has prevailed, the mathematical sciences have been esteemed as forming an extensive and valuable part of human knowledge. Their influence on the mind, independent of their practical utility in life, is alone sufficient to place them on a level with most other studies. They accustom the mind to attention. In the pursuit of this study, we are delighted with a succession of connected truths, which are evident when we understand the reasoning, but which do not appear at first sight to depend on each other. The pursuit of truth, gratifies a faculty implanted in us, as much as the pleasing of our senses; and the pleasure which we by that means derive, is free from the regret, the turpitude, and the intemperance which often attend sensual pleasures. When any one has felt pleasure, he will naturally wish for a repetition of it; but this he cannot have, unless he understands the reasoning by which any thing is shown to be true; and as mathematical truths are not obvious, he will be incited to study the reasoning by which any conclusion is aimed at. Attention is requisite for this purpose; and by endeavouring to attend closely to one subject, a habit of attention will soon be established.

By mathematical knowledge we acquire a habit of clear, demonstrative, and methodical reasoning. If we look into controversial writing, hear verbal disputes, or examine the foundations of many ingenious systems, we shall be surprised at what superficial reasonings satisfy the greatest part of mankind. The method of convincing which is often adopted, is to work upon the passions, rather than the judgment. A piece of wit, an anecdote, or a simile, is often advanced in place of solid sense. You may hear a subject, abundantly plain, obscured by reasoning the most foolish; and often you may see a man of plain common sense supporting a position, which scarce re-

quires proof, silenced by the noise or the laugh of his opponent, or knocked down by a quotation from Shakspeare or Hudibras. If with this we compare the reasoning of the geometrician, we shall find it is conducted in a manner diametrically the reverse.

From a few simple axioms and self-evident principles, we proceed gradually to the most general propositions, and remote analogies; deducing one truth from those already known, in a chain of reasoning infallibly connected, and logically pursued; and truth agreeably forces itself upon the mind, in the full tide of irresistible conviction.

By an attachment to these studies, we acquire an elevation of thought which fixes the mind, and prepares it for other pursuits; we follow with pleasure the same closeness of argument in other researches; and if we find a want of this accuracy, our mind, accustomed to the contemplation of truth undisguised, revolts indignant from the merely probable, the false or erroneous assertion, and reason disdains to assent to the sophisticated tale.

It is true, indeed, that in most other subjects, the same strictness of reasoning is impracticable, because their principles do not admit of the same degree of evidence; but still it is imitable in a certain degree. For proof of this I need only appeal to those works, the authors of which were mathematically inclined. Of these I shall only notice Smith's Wealth of Nations, Reid's Essays on the Powers of Man, and the writings of Dr. Beattie.

What has been said may recommend mathematics, as a useful exercise to the mind; the exercise of our mental powers is as necessary for giving a vigorous constitution of mind, as bodily exercise is for procuring health and strength to our frame. But it is not merely in a speculative view that the study of mathematics is advantageous; its application to other sciences and the arts, have given rise to many inventions, which are useful in every department of life.

The importance of mathematics as a preparation for other sciences, will be evident on considering their connexion and dependence on mathematical principles. We may observe, that all the objects of our knowledge are made in number, weight, and measure, and therefore to consider them we ought to understand arithmetic, geometry, and statics; and the greater advances we make in those arts, we are the more capable of considering such things as are the ordinary objects of our conceptions. But particularly we now know, with astonishing precision, the courses, periods, order, distances, and proportions of the several great bodies which compose our planetary system, at least of such as are within our view; and this affords a remarkable instance of the power of arithmetic, and geometry, well applied. Let us suppose ourselves placed at that stage of society, when the long course of observation and study necessary to bring astronomy to its present perfection, had yet to begin;—let us suppose ourselves ignorant of the most obvious revolutions and motions of our planet;—let us suppose ourselves ignorant of its periods and seasons, without instruments to make observations, without any idea of observations or instruments; —when would we expect that any of our posterity nould arrive at the art of predicting an eclipse? When would we suppose them ca-

pable of reckoning all the eclipses, past, or to come, for any number of years? When would we suppose that if conveyed to any distance from their home, that they should be able to tell how far from it they were, south, north, east, or west, or what course to take to return? We know that all this may be done, and is daily done, by what is known in astronomy; yet, when we consider the vast industry, sagacity, and the multitude of observations necessary for these purposes, we would be inclined to give up the pursuit as impossible to be attained; but by the assistance of the mathematical sciences, these things are now rendered so easy, that they may be performed by ordinary understandings.

What has been said of astronomy is equally true of geography and of navigation, sciences which depend upon astronomical and mathematical principles. To chronology these sciences are equally necessary; from the occurrence of circumstances related in many parts of ancient history, the precise dates have often been ascertained when some remarkable events have taken place. Thus Mr. Halley determined the day and hour of Julius Cæsar's landing in Britain; and the accounts of ancient eclipses, have, by this means, enabled us to tell exactly the dates of some events in history, which, without this verification, might be reckoned fabulous. Thus, in order to read history with advantage, some knowledge of geography and chronology are necessary.

Light is a considerable object of natural knowledge; but all inquiries concerning this body, are frivolous and futile, unless guided by geometry. I am not to be understood here as speaking of the ingenious theories of the chemists concerning this wonderful substance—with these, the geometers have nothing to do; but they have discovered two of the principal laws of its action, *viz.* in the reflection and refraction of its beams, and have invented the beautiful theory of optics, and of reflected and refracted vision, and have taught us to manage this subtile body, for the improvement of our knowledge, and for purposes useful in life. Geometers have likewise demonstrated the causes of several celestial appearances which arise from the inflexion of its beams, both in the planets, &c. and in the phenomena which arise in the atmosphere of our earth. Of the fluids which surround, or float upon the surface of the globe which we inhabit, air and water, little could be known but for the assistance of geometry and mechanics. The elasticity, and gravity, of air have been discovered by mechanical experiments. From these properties, geometricians have calculated the height of the atmosphere, as far as it has any sensible density, and the result agrees with another observation on the duration of the twilight. Air and water are the objects of hydrostatics, though denominated only from the latter. The principles of this science were established by Archimedes, and by the science is illustrated those natural appearances which depend on the gravity and motion of fluids, and the motion of solids in these fluids; in considering the different pressures, celerities, and resistances of these solids, many practical observations have been pointed out, necessary for the business of naval architecture; and the solid, which shall pass through a fluid with the least possible resistance, has been

ascertained. The calculations of mathematics on the motion of water through pipes, &c. are useful for several purposes. I might enumerate other arts and sciences which depend on mathematical principles. Thus perspective depends upon the rules of geometry and optics. The mathematics have reduced music to a regular system, by inventing its scales; and there is hardly any part of mathematics which is not subservient to architecture. I might descend to the animal frame. The eye, the only organ of sense which the geometers have considered, is the only one whose structure and manner of operation are understood. Every anatomist who would wish to understand the action of the bones and muscles, would need the knowledge of mechanics.

The usefulness of mathematics in several sciences and practical arts, is abundantly evident. They were reckoned by some of the ancient philosophers the key to all knowledge. Thus Plato had written above the door of his school, "Let no one ignorant of geometry enter here." It is not meant, however, that a knowledge of mathematics will enable any person to practise in any of the arts I have mentioned. Thus he who would attempt to compose music merely by his knowledge of harmonical numbers, could not be expected to produce very excellent pieces. To excel in several of those arts, besides the accuracy of rules, a person must be possessed of genius and fancy, and practice is necessary for them all. Yet still they owe their being to mathematics, which lays the foundation of their theory, and affords them precepts, which being once invented, are depended upon securely by practitioners. Thus, though many design who do not know the reasons of the rules by which they practise—though many compose music better, perhaps, than the inventor of the scale could have done, and know nothing of the numbers on which their harmony is founded, yet as the mathematics show the foundation of these arts, they must be necessary for their improvement; and surely it will be granted, that he who knows the fundamental principles of what he professes, has the best chance of excelling.

Hints to Paviers. *By* Colonel Maceroni.

[Continued from page 58.]

The next kinds of pavement that it may be necessary to mention, are those of Florence, of Sienna, of Milan, and some other cities of Northern Italy. These may, indeed, be assimilated to a kind of stone rail-road, as there are particular tracks allotted for the wheels, and others for the horses. The tracks for the wheels are composed of stones of very large dimensions; they are of marble, lumacelar limestone, or of a very hard sand stone; most of them, particularly at Florence, weighing several tons. They are laid with much precision, in lines of about three feet broad. The spaces for the horses, between these lines, are paved with small stones, and are, as well as I can recollect, about four feet wide. In some of the squares, the small pavement predominates; while the lines of large stone-way

cross it in every necessary direction. Nothing can be more easy or agreeable than this pavement, which is suitable to carriages of every description, without the limitation or confinement of an iron rail-road, but with nearly the same smoothness.

Among the causes which appear to me to have contributed to the extraordinary duration of these ancient Roman pavements, the geological nature of the surface over which they are constructed is not the least prominent. With the exception of the Pontine Marshes, and some tracts about Brindisi (Brundusium), Taranto, and Peruggia, nearly the whole of them have been carried over a surface of volcanic tufa, of greatly compressed Puzzolana, or of calcareous, or basaltic rock; all which furnish the best possible foundation. In countries where chalk, clay, gravel, or sand, are frequent at the surface, as in England, France, Alsace, part of Lombardy, &c., even these Roman pavements, when not kept in repair, have speedily become impracticable for carriages.

The size and weight of the stones composing the ancient Roman pavements, certainly do, *when once well laid on a compressed substratum*, oppose much *vis inertia* to the weights which roll over them, while their polyangular shape prevents any acute, or even right angles, being presented to partial pressure. This polyangular shape, and the excellent juxta-position of their sides, prevent any continuous line of junction being presented to the course of the wheels, which would so much tend to create ruts, and other irregularities; moreover, the stones being slightly pyramidical, produces a tendency to conduct the shocks towards the inferior centre of each, or laterally to the superior edges, which are well supported by the surrounding ones.

It is necessary also to remark, that the carriages used in Italy, both anciently and at the present time, are what would be deemed in England, very light. Besides which, the wheels of the modern Roman and Neapolitan carts are of a larger diameter than any used in England. It would appear that the carts of the ancient Romans were generally two-wheeled, drawn by two, or four oxen. Travelling was for the most part performed on horseback, or in litters carried by two mules. Chariots for travelling do not appear to have been used at all, much before the close of the republic. They were both two and four-wheeled, but not made to carry more than two persons, besides the driver. They do not appear to have had any springs; the wheels were very low, and not more than thirty-two or three inches apart. So that, altogether, it may be presumed they were more calculated to bruise the bones of the riders, than injure the pavements over which they bounced.

Such, in a very few words, are the best pavements I have had an opportunity of observing, and there is reason to believe there are no better existing. It does not, however, follow, because they are good, and perfectly well adapted to their respective purposes and localities, that any of them might be applied with advantage to the streets of London. I think it may be easily shown, that neither the ancient

nor modern Roman, the Tuscan, nor Neapolitan, would possess the qualities required for such an application.

To pave London after the ancient Roman plan, would, in the first place, be attended with enormous expense, and entirely new stones would be required for the whole undertaking. Stones of so large a surface would also become most dangerous for horses, at any pace faster than a walk, or when drawing heavy weights, or upon an acclivity. In London, wagons and carts are in general use, of far greater burthen than any which were anciently, or are at present, used in Italy. Some of our stages and vans, to a very considerable weight, moreover, add great velocity. I shall be told, perhaps, that in proportion to this horizontal velocity, the vertical gravitation is diminished; but these carriages have very small fore-wheels, upon which the drivers, with extraordinary stupidity, contrive to place the greater part of the load.* Such small wheels, so overloaded, descend with great violence into the least depression of the pavement, and are thrown up (to fall again) by the slightest protuberance.

I very much doubt whether, even in point of durability, either the Roman or Neapolitan pavements would succeed in London. Considering the friable nature of most descriptions of mortar, I suspect, that the repeated shocks of very heavy carriages would pulverize and detach it from the inferior surface of the stones, part of it would work out, and the stone become loose.† A further great objection to any such solid masonry pavements is, the frequent necessity of partially taking it up to lay gas and water pipes, and to repair our trumpery, crumbling, brick sewers.‡

The foregoing objections will equally apply to the modern Neapolitan pavements. The modern Roman has not the defect of being too smooth, but it has that of homogeneous solidity, which will not admit of its being perpetually displaced for the temporary purposes above mentioned. Moreover, where are we to get a sufficient quantity of such Puzzolana mortar as is employed in Italy, with which the pavement becomes as one rock?§

With regard to the pavements, or, as I have ventured to call them, the stone rail-ways of Florence, Sienne, Milan, &c. &c. the objec-

* The pertinacity with which this custom is followed, is somewhat surprising in this scientific country. What are we to say to the riders too? We frequently see five or six in front on a stage coach, without a single person behind, or even inside!

† I have seen portions of ancient Roman road broken up by the passage of heavy artillery. A very few such large stones displaced, will render the road impassable for carriages.

‡ Our sewers are admirably planned and levelled, but the materials and the construction are very short of the necessary solidity.

§ I have frequently seen portions of such pavements undermined, and displaced by torrents, without a single stone being detached from the masses of several square yards' surface, into which the pavement was broken. On one occasion I remember the water having undermined the whole breadth of pavement, so as to admit of my crawling under it from one side to the other. I immediately after passed over it in my carriage, as safely as over a bridge.

tions to their adaptation to the streets of London must also be obvious enough. Independently of the enormous expense of the materials, such a system could never answer in streets where vehicles of all descriptions, going at every degree of velocity, have occasion to cross, pass, and run abreast of each other, over the entire breadth of the street. Such large stones, whether of granite or limestone, would soon become dangerously smooth, their longitudinal edges would wear, and ruts continually be formed along them.*

It remains for me to observe a new method of paving, which has been lately attempted in Piccadilly, but which I am confident will not be found to possess any advantages over the old plan in general

* In that delectable imitation of the French, which is exhibited on the Hammersmith road, of which one portion is paved and the other not, the high ridge, which must perpetually exist at the edge of the paved portion, has afforded many good jobs to the surgeons and wheelwrights. *A propos* of French roads—I will venture to digress so far as to observe, that with the exception of their straightness, their construction in other points is very bad. They are in general three times too wide—they are too much arched or elevated in the middle, and when this part of them is paved, nothing is done to the lateral portions, which are not. From being too wide, so much care cannot be bestowed on their construction, at the same expense as would suffice were they narrower. Secondly, the carriages and carts not being obliged to get out of each other's way, form regular tracks and ruts for those going and those coming, out of which they never dream of moving. These French carts and wagons are of quite as barbarous and rude a construction as they could have been in the days of Clovis or Charlemagne, save and except, peradventure, that very ingenious invention of the modern French, for the express purpose of enabling the said carts to keep exactly and undeviatingly in the same ruts. For whereas in different districts the carts vary more or less in width, so that cart A would not be able to go exactly in the rut of cart B, it is contrived, that their axletrees should have six or seven inches to spare, over and above the portion confined in the nave of each wheel. The linch pin is affixed to the extremity of the axle, so that the wheels are at liberty to wash to and fro from side to side, and adapt themselves exactly to the ruts, which the French road-makers so highly appreciate. In passing by a French cart you must therefore be careful to allow for, at least, six inches of concealed axle, which ever and anon darts out from the nave, like the tongue from the mouth of a snake.

The middle portion of a French road, which is generally paved, is so much arched, that carts are naturally induced, if not compelled, to take the centre of it; so that those going in opposite directions invariably use the same track, out of which they only momentarily move at the instant of meeting. Deep ruts are thus soon worn even in the most substantial pavement—the difficulty of repairing which, unless throughout the whole extent at once, must be sufficiently obvious. I have here alluded only to the two or three main roads of France. In the others, which they regard as secondary ones, I have travelled for scores of miles where the ruts have been so deep, that on one of my wheels falling in, it could not touch the bottom, but rested on the nave and axle.

Besides the consequences of the defects of locality and of materials, I have remarked three principal causes of the speedy deterioration of highways. Their being too wide—too much arched—or having but little traffic upon them;—all which circumstances conduce to the carriages keeping in one track, and to the consequent formation of ruts and holes. The only defect in the English high roads, is their having so many unnecessary, and often dangerous turnings and windings. Here and there, they are even too narrow; and buildings have been suffered to encroach upon them.

use, *at all commensurate to the great inconvenience and expense attending its formation.* According to this method, the old pavement is taken up for a space of about thirty or forty yards at a time, and a regular road is laid with gravel and broken granite, *à la M'Adam*, upon which the paving stones are subsequently laid, and the operation repeated for another forty yards. It, however, takes at least ten days or a fortnight to harden in succession each of these tracts, sufficiently for the application of the paving stones, and these successive hardenings are to be performed by the carts, carriages, and horses of the public, with so much inconvenience and annoyance as amount to a complete nuisance! After all, this pavement of such troublesome and *expensive* production, will not stand much longer than the old. When any portion of it has to be taken up, for pipe laying, &c., how is that portion to be restored to an equal density with the rest? In fact, there is no species of pavement that I have ever seen or heard of, to the application of which to the streets of London, there would not be many great objections. I, however, flatter myself, that, after much observation and reflection, *I have hit upon a method that would combine economy with durability, and with what is here quite indispensable, the admissibility of partially and frequently disturbing it, with no greater inconvenience or expense than occurs according to the present system.*

Having thus far therefore endeavoured to show, that solid cement-laid pavements, or even such as derive their solidity from the size and weight of the stones, would severally present many objections to their adaptation to the streets of London; I now will proceed to state what I conceive would prove a cheap and efficacious succedaneum.

The author then proceeds to give the explanation of his system of pressure, which has been already inserted in our last number, p. 58.

ESSAYS ON BLEACHING.

By James Rennie, A. M. Lecturer on Philosophy, &c. &c. London.

No. II.—BLEACHING APPARATUS.

SECTION II.—The apparatus for preparing the different combinations of chlorine with the alkalies, with lime, or with water, has also been somewhat improved since its first invention by Berthollet, but this has only been the case in the materials used for its construction, and in some of its less important parts: the principles on which it is now made, are the same as in the earliest periods of its employment. Mr. Rupp, (Manchester Memoirs, V. p. 301, in a note,) complains of Berthollet's apparatus as too complex for a manufactory, and recommends a range of four, five, or six hogsheads, or rum puncheons, connected with one another in the manner of Woulfe's apparatus, as being greatly preferable. It will be recollected that this is exactly the method which was resorted to by the Aberdeen bleachers, when they found it inconvenient to use glass.

The one now commonly used is said by Ramsay to have been contrived by Mr. Fisher of Rutherglen; that which I shall now describe as the best which has come to my knowledge, is somewhat different from Mr. Fisher's as described by Ramsay, and is that used by the most enlightened bleachers in England and Ireland. Over a furnace constructed in the usual way, is placed a cast iron vessel containing water, which forms a water bath for the reception of a still. This still, into which is put the materials for furnishing chlorine, is made of lead, and properly adapted, both in form and size, to the cast iron water bath in which it stands. The top of the still is furnished with water lutes, to keep the apparatus tight and prevent the gas from escaping. These lutes are best made of loose flax, dipped in white lead which has been ground in oil. The head of the still is also of lead, and is sufficiently large to allow of its dipping, six inches, into the gutter of water which surrounds the body of the still; whence it can be taken off, or put on at pleasure. In the top is made a circular hole of three inches diameter, to introduce the materials, and occasionally to clean out the still. The whole is fitted with a plug of lead, which is gently struck into the cover when the apparatus is arranged for working, and is luted with soft clay to prevent the escape of gas. To agitate the materials, there is fixed in the still, a *stirrer*, consisting of a square frame of wood covered with lead. From the still there runs a bent tube, to convey the gas to the receiver for the alkaline solutions. But before it is admitted into this, it passes into a small circular vessel, which is, according to the proportion of the apparatus, from twelve to eighteen inches diameter, and contains water in order to arrest any uncombined chlorine which may arise in the process; but since the water bath has been substituted for the sand bath, this seldom occurs. The gas is then admitted into a large receiver, charged with the alkaline, or calcareous solution, intended to receive and absorb the chlorine gas which comes from the still, and when sufficiently saturated it is drawn off by a brass cock fixed at about two inches from the bottom of the receiver. The receiver is of a square form, or that of an inverted cone, and is made of lead, where the capacity does not exceed 120 gallons, and of wood lined with lead, when the business is extensive. It is closely covered at top, and has a hole for introducing water into a receiver with a leaden plug. In some manufactories, two or three false bottoms made of lead, are laid on brackets of the same metal, fixed to the side of the receiver. These false bottoms are perforated, or made of spar work, in order to spread the chlorine through the water during distillation. The solution is constantly stirred, to promote the absorption of the gas, by an agitator, which, in large works, is driven by a power from a steam engine.—(Parkes. Ramsay.)

In recovering alkali from waste leys, it is found more economical to construct what are called stone boilers, than to employ vessels either of lead or iron. Stone boilers are large oblong chambers, whose lateral walls are about two feet high, and are built into the ground to prevent their giving way. The outside wall is well rammed with tempered clay puddle, to prevent leakage. An arch of

brick is thrown over between the walls, which is covered with mortar to retain the heat. Proper openings are at the same time left, by which to examine the state of the liquid; these are covered with a plate of iron. At one end of the chamber, a furnace of a sufficient capacity is built, having a breast work interposed between it and the liquid, over which the flame plays. At the other end of the chamber, a vent of a sufficient height is built to carry off the smoke. The fire being lighted, the flame plays along the surface of the liquid, which by this means is evaporated. Some of these stone boilers are so capacious as to contain 10,000 gallons. (Ramsay.)

When stone boilers are not used, common evaporating pans may be employed, and particularly in works of moderate extent. After the leys have been brought to a due consistence, the materials are removed to a small reverberatory furnace, and gently calcined. A common baker's oven is well adapted for this purpose, and is used, as we learn from Des Charmes, (p. 87,) in the manufactories of France. If the former is preferred, the process should, if possible, be continued night and day; or, at least, the fires should be raked up at night, and the passages of the chimneys carefully stopped. Furnaces which are thus wrought, will last seven times as long as those where it is not attended to; insomuch as the contraction of the materials, during the time of cooling, and their subsequent expansion, wear them rapidly out. (Parkes.)

To avoid the inconvenience and injury, arising from the escape of the noxious vapours of chlorine from the bleaching liquors, and to have the goods more equally exposed, than in the old mode of stratifying them above one another in large vessels, Mr. Rupp, of Manchester, contrived an apparatus extremely simple and ingenious. It consists of an oblong deal cistern, made water tight, with two perpendicular beams, made to turn round on their axles, and each furnished at the lower end with a plain pully of a large diameter. On one of these beams the cloth is rolled, after the pieces are slightly sewed together. This cistern is filled with the bleaching liquor, and the cloth is wound by means of a winch from one beam to another several times successively, so as to expose the whole of its surface equally to the fluid.

I shall conclude this part of my subject with a few practical notices, which are of importance to be attended to in conducting extensive bleaching manufactories.

1. When boilers are set in brick work, care should be taken not to make the fire places too large, for when the bars are not entirely covered with fuel, the cold air rushes in from the ash pit, between the uncovered bars, and counteracts the effects of the heat. Fire places should be no larger than is barely necessary for the fuel to produce the intended effect. They should be so constructed also, that the whole bottom of the boiler may be exposed to the action of the burning fuel, and that the whole of the flame and heated air, actually impinge upon the bottom, before they reach the sides to pass to the chimney; for the heat applied to the bottom will be infinitely more effective than that applied to the sides. To aid this, some large stills and

coppers are made with the bottom to project inwards, presenting a concave surface to the flame; some have, for the same purpose, a flue of 10 or 30 inches diameter running through them. (Parkes.)

2. As cast iron is so liable to break from its unequal expansion when submitted to heat, steam engine boilers are now usually made at a great expense, with plates of wrought iron rivetted together, which, in the end, prove to be cheaper, from their great durability. But much expense might be saved by making the *upper* part of cast iron, as that does not suffer from the action of fire. This might be attached by screws, and when the old bottom was worn out, it could be removed, and a new one put in its place. The vessel would then be as good as at first. (Parkes.)

3. In works where large and expensive iron boilers are used, sulphurous coals ought to be avoided if possible, as the sulphur rises during combustion, unites with the iron of the boiler, and forms a sulphuret of that metal, which wastes away as fast as it is formed, and soon renders the boiler totally useless. (Parkes.)

4. In places where peat is to be had, it is an economical fuel in manufactories. In some places of Scotland, we are told by Mr. Mushet, (Phil. Mag. VII. p. 44,) that it can easily be procured at a shilling per ton; and four tons of dried peat, as he distinctly shows, will make something more than one ton of peat char; a substance which produces a much stronger fire than coals, or coke. M. Sage informs us, that he found, by repeated experiments, that the turf char produces a heat nearly in the proportion of 3 to 1 of the best charcoal. But while we can say this much, we must not conceal, that it is not easy to make peat char, as it requires a peculiarity of management which can only be acquired by considerable experience.* (Parkes.)

5. A great deal of the sheet lead in the market is manufactured from old lead, and, consequently, contains solder and other impurities. Such lead ought carefully to be avoided in the construction of retorts and chambers; for a small portion of tin, or plumber's solder, will reduce the melting point of the metal, very considerably. Lead, for example, melts at 612° Fah. but with $\frac{1}{25}$ of tin, the melting point is at 558°; with $\frac{1}{14}$, at 555°; and with $\frac{1}{9}$, at 530°. Upon the same principles, Des Charmes cautions the manufacturer against joining any of his lead vessels by soldering, and recommends the fusing of the parts to be joined, as preferable; "for," says he, "in process of time the solder, though ever so strong, yet because it contains tin, is liable to excessive corrosion by chlorine, which is not found to attack lead, even when heated in any sensible degree." But if it cannot be managed without solder, the parts soldered must be defended by several coats of white lead, putty, rosin, or pitch mixed with bees' wax; any of which, experience proves to effectually answer the end. Lead is sometimes used for lining or securing parts of the kier which are thought to be in danger of leaking. Now, the

* Mr. Mushet has written several very instructive papers on this subject; see particularly Phil. Mag. vol. XXXII.

sulphur which is always contained more or less in potash, acts upon lead, forms a sulphuret, which being of a red colour, is liable to produce stains. (Parkes.)

6. I shall here mention a circumstance which, although it may seem trivial, is of some importance; namely, that in the roofs of bucking houses there should not, as there sometimes is, be any iron nails; for the steam from the boiling vessels will be condensed by the tiles; and the water thence arising, will wash off from the nails, the oxide which it contributes to form, and this, falling on the cloth, will produce stains, of whose origin the workmen may often be at a loss to discover the cause. No iron ought to be used in the roof of a bleaching house, nor any lime on the inner side of the walls. (Parkes.)

7. As some of the vessels in the bleaching process, may, when fuel is scarce, be heated by steam, and as in every case dryers and other parts of the apparatus are actually so heated, it will be useful to mention, that as charcoal is a very slow conductor of caloric, (in proportion to dry sand, as 3 to 2,) if all those vessels which are heated by steam, were made double, and the space between the outer, and the inner vessel, filled with ground charcoal, the heat would be so prevented from escaping, and any one particular temperature might be kept up for a great length of time, and make a material saving in fuel. (Parkes.)

8. Since the adoption of the dry oxymuriate of lime, the distilling apparatus is less used than formerly, as the bleachers buy this salt ready prepared. It is still used, however, in making oxymuriates of the alkalies. In this process, it is of the utmost importance to attend to careful luting; so much so, that Des Charmes affirms, (page 4,) "that the single obstacle of not knowing how to manage lutes, is quite sufficient to repel the efforts of the most zealous, in this kind of operation." To compose the fat lute of the chemists, take any quanty of good gray or blue clay, or fuller's earth, and dry it in thin cakes in an oven; then pound it finely and sift it; beat a sufficient quantity of this pulverised clay, with boiled linseed oil, in an iron or bell-metal mortar, till the whole mass is of a uniform colour; it will then be fit for use. That which has been made for a twelvemonth, if it have been kept in a covered earthen pot in a cellar, is better and more pliant, than when newly made. A large quantity ought always to be made beforehand, when the work is extensive. "I strongly insist," says Des Charmes, page 14, "on the perfection of this lute, because it is the soul of the distillation process."

FOR THE FRANKLIN JOURNAL.

Remarks on burning Anthracite in open fire places.

A paper was lately published in the Franklin Journal, on the use of stone coal, for the purposes of cookery, with the design of establishing the fact, that anthracite may be thus employed very advantageously, in a common fire place, and without the aid of a blower.

The experiments performed by Mr. Vaux, were made in April of the last year, and his full success has been reported by a Committee of the Franklin Institute.

I do not intend to detract in the least, from the credit due to Mr. Vaux, but think it right to state, that a grate, very similar to the one of which a plate with details has been given to the public, was in full operation, in my house, during the whole of last winter. It was more simple, however, than that of Mr. V.'s, and the one which I now have in use (put up in August last) is still less complicated. In place of the marble, or soap-stone top, I employ sheet iron; because it affords, by reason of its superior conducting power, a more extended surface for the operations of cookery. In lieu of an iron plate partition, for the purpose of making a small fire occasionally, I have a slip-grate, which, by being raised or lowered, lessens or augments the receptacle of coal, at pleasure.

But the *principle* of all this simplification was established, even anteriorly to the construction of my first grate, in September, 1825; and it was the observance of this principle, in an apparatus presently to be noticed, that led to the formation of the simple grate first used in my kitchen. Every one, almost, has seen, and many have purchased the summer furnaces for burning charcoal, which were originally of a circular form, but which were so modified in some instances, as to be of a semicircular shape in the upper two-thirds, the lower third remaining round. These have been denominated the *half moon furnaces*, and are always coated with sheet iron. Those who understand the management of Lehigh coal, can, with ease, kindle a good fire in the half moon furnace, by first igniting some charcoal, dry oak, or hickory, and then throwing on the stone coal in pieces of about the size of an egg. In a common fire place, or in the open air, a furnace of this kind may be used for burning Lehigh coal, unaided by any thing in the shape of a blower. During the whole of last summer, a furnace of the above description, with one of the round furnaces, served my family for all the purposes of domestic economy, in which fire was requisite; and stone coal was burnt in both, though to most advantage in the half moon furnace.

I have been well satisfied for more than a year, that Lehigh coal can be burnt with far less trouble than many persons imagine, and agree fully with Mr. Vaux, that it would be more generally preferred for cooking, if its advantages were better understood. A coal fire made in my grate (noticed in the former part of this statement) at ten o'clock, A. M. for the purpose of roasting, will burn well, undisturbed, until from six to eight in the evening, and then nearly a third of the coal will remain. What sort of wood fire can be kept up for so long a time, with so little trouble?*

Thos. D. Mitchell.

Frankford, January 9th, 1826.

* My grate will hold, probably, a peck and a half.

Additional Remarks on Anthracite—By the Editor.

We were much gratified by the preceding communication from Mr. Mitchell; for although the fact has been long known to us, that anthracite might be burned without that great draft, and those other special preparations, which are generally deemed requisite, yet experience has taught us, that the publication of one or two experiments, however satisfactory, or however well authenticated they may be, will go but little way in removing strong prejudices. Mr. Vaux did not, in his communication, pretend to have made a new discovery, but only to have given a clear and striking exemplification of a fact, which, although known to some persons, was contrary to the general belief. The committee of the Franklin Institute, who reported upon the experiments of Mr. Vaux, were well aware of what had been previously done in this city, and elsewhere; and carefully avoided the giving a higher degree of credit to that gentleman than they believed to be merited by the industry with which he prosecuted, and the success with which he performed his experiments.

The Editor of the Miner's Journal had stated, nearly two years since, that "a chimney with the worst draft possible, will do for burning anthracite, perhaps better than one with a quick draft; for the fire burns more steadily, and of course the heat is more equal. If there be an aperture sufficiently large to carry off the small quantity of gas disengaged in the combustion of stone coal, it is all that is required."

"I have seen a fire, of our coal, burning delightfully in an open grate, in a large open kitchen fire place, within which half a dozen people might stand around the fire, and the chimney of which smoked to such a degree with a wood fire, that it was almost impossible to stay in the room." In the same paper, many other facts had been stated, proving the facility, and economy with which anthracite might be used, for almost every purpose for which fuel is necessary. These facts were *confirmed* by the experience of Mr. Vaux, and of others; and during the last summer, several of our citizens burned stone coal, in the open air; using the ordinary earthen furnaces. There are now a number of kitchens in which the whole of the cooking is satisfactorily performed with stone coal, in open grates. Mr. Thos. Hughs, Mr. John Moss, and several other gentlemen, have also perpetual ovens, which are heated by the fires in their grates, and which most completely answer the intended purpose. The grate in which Mr. Hughs burns the Lehigh coal, was made for the bituminous coal, and is of the kind which, in England, is called a kitchen range. The servants frequently place their kettles immediately upon the coals, with but little detriment to the fire; it is certainly better, however, to employ a trivet. Mr. Joseph Trueman has lately constructed a fire place in his kitchen, which promises to answer well. The grate is of the usual form; there is, upon that part of the hearth which is immediately under it, a grating which allows the ashes to fall into a receptacle in the cellar, whilst it admits an abundant draft of air to support the combustion; and which may be regulated by a valve. The jambs are built with brick, and in each there is a round hole left, in

the form of a chaffing dish, or furnace, with draft holes, and doors; both of which may be used at pleasure, as they are independent of the grate.

Such is the facility with which the stone coal is now managed in its combustion, that many persons are already at a loss to discover wherein consisted those difficulties which were encountered in the first attempts to use it; and we believe that the time will soon arrive, when our servants will, if required to use wood for cooking fires, object to it on account of the *difficulty* in managing it. In London, where bituminous coal is the only fuel, the whole corps of cooks would rise in open rebellion, were they required to substitute wood, in their operations; and we think that our stone coal is as much to be preferred to the bituminous kind, in all the operations of the kitchen, as our servants now think wood, is preferable to anthracite.

Novel as is the use of stone coal in the city of Philadelphia, it has been employed for upwards of fifty years, in some parts of the state. "Judge Gore, of Wilkesbarre, first used anthracite, or the Wilkesbarre coal, in his blacksmith-shop about the year 1770; and no other coal has been generally used in the Wyoming Valley, since that period. Judge Fell first introduced the *grate* for burning anthracite about eighteen years since. It was substantially the same as that now used for common domestic purposes, and has received very little improvement, other than ornament."* Were it necessary to exemplify the tardiness with which we learn, and profit by, the example set by our immediate neighbours, when our domestic habits are concerned, the facts above cited would be sufficient for the purpose.

A very injurious practice is generally pursued in the setting of our grates. This may be collected from some of the preceding remarks, but it is a point of so much importance as to merit a more particular notice. We allude to the strong draft which is given; as is evinced in the furnace-like roar of most of our fire places. The effect of this is to burn out the fuel with great rapidity, and to send a large portion of the heat up the chimney. Many of our workmen, having once adopted this plan, will pertinaciously adhere to it; and it will be necessary for those who are to pay for the coal, and to sit by the fires, to inform themselves on this subject, and to insist upon having the work performed in such a way as shall promote economy and comfort.

Many intelligent engineers have expressed an opinion, that anthracite would never be found to answer well in steam engine boilers. We are however informed, that at the Phœnix Nail Works, stone coal has been used for many months, and that it is preferred to every other kind of fuel; the fire place, we believe, was not constructed with a view to the employment of stone coal, but a little practice has served to prove that the difficulties anticipated in the use of it, were imaginary. It would indeed be strange, if a fuel so readily burned, and giving out an intense heat, should be incapable of having its heat combined with water, so as to convert it into steam.

* Miner's Journal.

Observations upon the Automaton Chess Player, now exhibiting in this city, by Mr. Mælzel, *and upon various Automata and Androides.—By the Editor.*

We have not the vanity to attempt offering any new speculations upon the subject of the *Androides*, usually denominated the *Automaton* Chess Player. Several publications have been devoted exclusively to the history of this figure, and an investigation of the probable mode in which it is made to operate; and many public journals, as well as most of the existing Encyclopedias, have noticed the subject. Wherever it has been exhibited, from the time of its first appearance, in the year 1769, to the present day, it has excited the ardent curiosity of all classes of society; and has been examined with a scrutinizing eye, by the Philosopher and the Mechanician; no novelty ought therefore to be expected from us, excepting, perhaps, in the manner of telling our thoughts.

The name of *Automaton*, which has been given to the chess player, is not in this case correctly applied; as an automaton has been defined to be *a self-moving machine, so constructed, that by means of internal springs and weights, it may move a considerable time, as if endowed with life.* Under this definition are included those results only, which are produced wholly by the operation of mechanical instruments: but were a figure exhibited, which should write an essay, or a poem, upon any subject which might be prescribed, every one would at once determine, that the motions of the hand *must* be under the guidance of intellectual agency; and the same conclusion applies, as necessarily, to a game of chess, as to any literary effort.

The chess player belongs properly to that class of figures which is denominated *androides*, a name derived from two Greek words, signifying *a man*, and *form*; it includes therefore all those figures which have been made to imitate the form, and actions of man, although a part, or the whole of the actions exhibited may be produced by a concealed intelligent agent. We will in a future number give a detailed account of some of the most ingenious contrivances, both of ancient and modern times, which belong to one or the other of the two classes of machines which we have named; at present our observations will be confined principally to the chess player.

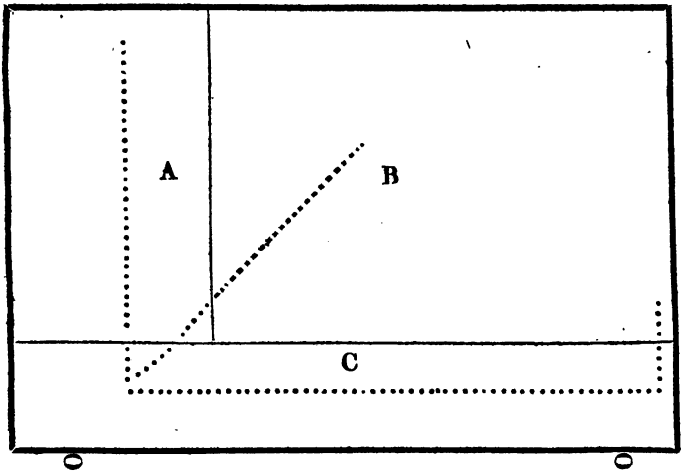
Baron Von Kempelen, (frequently written de Kempelen,) the inventor of this *androides*, was a native of Presburg, in the kingdom of Hungary, and was a member of the Aulic council of the German empire. He was a man of considerable talents, not only as a mechanician, but in general literature also, and published several dramatic and poetical compositions. He likewise published a very curious and interesting work, entitled "The Mechanism of the Voice, with a description of a speaking machine, illustrated by 27 plates." He succeeded more perfectly in imitating the human voice by means of machinery, than had any other person; unless we admit as evidence to the contrary, tales which bring with them evident marks of exaggeration, or of fiction. The fame acquired by the chess player has, however, served almost to eclipse the other works of this gentleman,

although the *real merit* of some of his productions was probably greater than that of this popular work. M. Von Kempelen's own observation with respect to it, was, "It is an amusing trifle, which possesses some merit on the score of its mechanism; but, that it appears so wonderful, is principally owing to the boldness of the idea, and to the happy choice of the means employed to render the *illusion* perfect."

The chess player was completed in the year 1769, and was exhibited in various parts of Germany; it was afterwards taken to Paris, and in the year 1783, was first shown in London. It was always accompanied, and exhibited by Kempelen himself. It has been already stated, that several publications have appeared, intending to show the manner in which the moves were, probably, directed; and the whole of these investigations seem necessarily to lead to the same conclusion; namely, that there *must* be some person concealed *within the instrument*, by whom the moves are made, through the intervention of machinery operating upon the principle of the pentagraph.

Von Kempelen had relinquished the exhibition of his figure for some years before his death: this has been generally attributed to some of the publications respecting it; but more particularly to a work which appeared in Dresden, written by Mr. Frederic Freyhere, a gentleman of known talents, whose book was accompanied by several coloured plates. Mr. Thomas Collinson, a man of science, saw Von Kempelen in the year 1790, soon after the publication of Freyhere's book, and found him quite silent upon the subject of the chess player; a circumstance which served to strengthen the impression, that the explanation which had been given, was the true one. In the 8th No. of the Edinburg Philosophical Journal, for April, 1821, there is a notice of a work which had just been published, entitled, "An attempt to analyse the automaton chess player, of M. De Kempelen." This notice is accompanied by a plate, intended to prove the possibility of concealing *a full grown man* within the chest, or commode, behind which the figure is seated. A copy of this plate, together with the explanations given, have been recently published in Boston, in a pamphlet which is for sale by Messrs. Carey and Lea, of this city. We would have procured a cut for the purpose of illustration, could it have been finished in time for the present number; but as the figure is now exhibiting in our city, we were unwilling to delay the present article, and all we can now do is to give a rough diagram, in order to render our description more plain than we could otherwise make it.

The following diagram represents the front of the commode, or table, behind which the figure is seated; it is about 3 feet 6 inches long, and 2 feet 6 inches in height; an ordinary sized man might therefore seat himself within it, in the direction of the perpendicular and horizontal dotted lines. The space A, is covered by a door, and there is a corresponding door at the back of the commode. The space B, has folding doors, and a door also at the back; C, is occupied by a drawer.



The exhibition commences by wheeling the commode, with the figure attached to it, from behind a curtain. The doors are all, at this time closed, and it is evident that the whole is completely isolated, as respects any external moving agent. Communication by means of strings or wires through the floor, or through the air, is altogether out of the question. The door at A, is first opened, the opposite door, at the back, is then opened, and a candle held behind, to enable the audience to see completely through this part of the commode. The lower part of this cavity, towards the front, contains a brass barrel, resembling that of an organ; this passes all across, and may be from three to four inches in diameter. There are also several brass wheels, and other appendages, which appear to occupy a large portion of the whole cavity, but which probably extend but a few inches within, leaving a clear space towards the back. The drawer is also partially opened, which, however, is supposed not to extend through more than half the depth of the commode, and to allow room behind it, for the legs and thighs of the occupant. When the two doors are open, the body may be bent forward into the cavity B, in the direction of the diagonal dotted line: the back door is then closed and locked, and the upright position of the body, may be resumed; for although the front door is still left open, the supposed space at the back is so much concealed by the wheels, &c., and so completely in shade, that a person within covered with sombre coloured garments, could not be seen. The front and back doors of the part B, may now be opened, and a light placed within them, without the slightest danger of betraying the secret. We deem it unnecessary to speculate upon the mode in which the individual within, may perceive the moves upon the board; several different conjectures have been made upon this point; we think that it presents no great difficulty, and that it might be accomplished in various ways.

We fully accord with the writer of the Boston pamphlet, in his remark, that the impression made on the mind, when the figure is seen for the first time, is, that it is impossible an intelligent agent should be concealed in the box. We were prepossessed with the idea, that this was really the case; still, the first actual exhibition had a tendency to weaken the impression, although a subsequent examination has restored, and almost confirmed this first opinion. The difficulties upon any other supposition, appear to be insuperable, and many of those fancies, which present themselves to the minds of those, who have only heard or read of the Automaton chess player, are completely dissipated when the exhibition is witnessed.

The objections which have been urged against this explanation, we do not think formidable. An intelligent youth, brought up to play the game of chess as a matter of business, would become an expert player, in the course of a year or two; and it is highly probable that the exhibiter may occasionally direct the moves, by preconcerted signs. It is said that when the thing was shown by the inventor, whoever could beat Kempelen, could beat the androides. A greater difficulty, in the estimation of many, is the danger that the concealed individual would cough or sneeze, during the time of exhibition; it will be found, however, that when in health, the inclination for these may be almost always suppressed; a concealed robber suffers, we apprehend, but little uneasiness from a fear of betraying himself in this way: the exhibition of the chess player is terminated in about an hour and a half, and should an absolute necessity exist, for removing it, before the expiration of this time, some token might easily be given, and a satisfactory excuse made to the audience. Numerous other exhibitions have depended upon a concealed accomplice, and in many instances, on one concealed for a longer period of time, than our supposed chess player is imprisoned at a *sitting*.

Were it indeed *impossible*, that any part of the table should be occupied by a concealed player, this impossibility might, without difficulty, be rendered perfectly evident to every visiter; but the united opinion of nearly all who have carefully investigated the subject, goes to prove that such a concealment is more than possible. Now, surely this is an opinion which every one must feel as calculated very materially to lessen the interest of the exhibition; yet it is one which has been long, and well known, to exist. If it *can* be destroyed, why is it allowed to continue? So far from its being either necessary or useful as a mere *ruse*, a removal of the suspicion which has existed so long, and so generally, would make the operation of the machine appear altogether inscrutable, and give to the automaton, as it were, a new creation. Why then, we again ask, is it allowed to continue, if it *can* be removed? That it *is* allowed, seems to us to amount almost to a demonstration that it is well founded.

The assertion so often repeated, that the automaton has never been beaten, or that it has been beaten but three times, once in Paris, once in London, and once in Boston, is well known to be incorrect. Expert chess players are not numerous, and the figure may therefore well get the game, in by far the greater number of in-

stances: among those who play publicly, there are, probably, but few who do justice to their own skill; the very nature of their situation almost forbids this.

The androides was beaten in a full game, by a lady in this city: and should it even be admitted, that *politeness* on the part of his Turkship, had something to do with this event, many other instances might be cited. Full games are rarely played, but in one held at three different sittings, and which lasted, altogether, five hours, an eminent player of Philadelphia made a drawn game. The Turk appeared in this case to be very hard pushed, as his pauses were long, one of which amounted to seven minutes and a half. Ends of games are those usually played—these serve fully to test the powers of the antagonists, and have repeatedly been gained by skilful players, opposing the androides. These remarks are merely intended to correct a prevailing error, and do not, in our estimation, detract, in the least, from the merit of the performance.

The exhibiter sometimes touches the table with his hand, during the progress of the game; at other times several moves are made without this being done; he is in the habit of putting his hands behind him, and moving his fingers in a way somewhat peculiar; he also works his feet upon the floor, in an unusual manner. These motions, we think, are intended to attract and divide the attention of the audience, and to excite their speculations; though they certainly may also serve as an envelop for real signals, should such be made.

Magnetism has often been spoken of as an agent which may probably be employed; it is mentioned in some of the books upon the subject; and as a proof that it was not used, it is stated that Von Kempelen allowed a strong magnet to be placed upon the table near to the figure. It is no uncommon thing when difficulties are encountered in producing certain motions, to ascribe them to magnetism. If those who speak thus would attempt to inform us *how* the effects might be produced by the aid of a magnet, they would generally manifest an entire ignorance upon the subject of magnetism, or find themselves involved in inextricable difficulty. This remark, we think, applies, in full force, to the subject in hand. The writer of the article in the Edinburg Journal, says, "If the impossibility of a chess player being concealed in the machine had been fully established, we should have had *no hesitation* in considering magnetism as the moving power." We think, however, that had he attempted to *apply* a magnet, so as to produce the effect, he would have found some cause for hesitation. But magnetism is sometimes as convenient as an *occult quality*.

As a work of art, the chess player possesses but little merit; the face is deficient in character and expression; its eyes roll in a manner altogether unnatural, and in making the moves, its hand and fingers exhibit a very faint resemblance to the action of a living being; the motions of the head are like those of the figures of Chinese mandarins. These, however, are minor considerations, and we are convinced that Mr. Maelzel, were he to construct a new machine, would, in these particulars, manifest much greater skill, than has been evinced by Von Kempelen in his chess player.

For the information of those who have not seen the exhibition, we ought to mention, that the chess board, upon which the moves are made by the figure, is firmly fixed upon the commode. A table, with another chess board, is placed in front; at this table the antagonist of the figure is seated, and the moves made by either, are repeated by Mr. Maelzel, on the opposite board. The figure plays with the left hand, which, when not in action, rests upon a cushion placed near to the board; the right hand rests upon the table, and if a false move be made, the figure notices it by striking this hand repeatedly upon the table, and shaking his head; after which, he returns the piece to its proper place, and makes his own move. A square black box, or board, is put upon the table, and near to the cushion; upon this board, or box, the figure deposits the pieces which he takes from his adversary. It is said, that Von Kempelen frequently consulted this box with great apparent care, and pretended that in it was contained the essential part of the secret, which he could communicate in a moment. No use is now made of this, excepting for the purpose above noticed. The exhibiter occasionally winds up some part of the machinery, but this is sometimes omitted, and is therefore unnecessary. When the arm of the figure is in motion, a noise is heard like that of the running down of a clock. To common observers, this gives the idea that the arm is moved by the machinery; but a little attention will render it more probable, that the wheels are moved by the arm. When the interior of the commode is shown, the drawer in the lower part of it is opened a few inches; some articles are taken out of it, and it is then closed. This drawer, we think, is made without a back, which prevents the distance to which it extends, being perceived by the spectator.

We are indebted to the present proprietor of the chess player, for some important information respecting its history. Mr. Maelzel, who was well acquainted with Von Kempelen, is undoubtedly a very ingenious, and, apparently, a candid man. The determination to make this machine, says Mr. Maelzel, originated in the surprise excited in the court of the Empress, Maria Theresa, by the performances of an eminent juggler. Von Kempelen had been invited to court to witness this exhibition, and after the performance, declared that he would produce something, which should surpass any thing they had then seen; and in due time he completed his chess player. Von Kempelen ceased to exhibit his machine soon after his tour in England. Mr. Maelzel states that his reason for this was, that being a man of fortune and station, he was unwilling to continue in this business. Another reason, however, was given by the late Mrs. Rivardi, to a gentleman well known in this city: she stated, that she was well acquainted with Von Kempelen, and with his family; that his daughter, a girl of 12 years of age, and an excellent chess player, was his coadjutor; and that her health declining, from the confinement to which she was subjected, it became necessary to stop the exhibition. We leave this relation to stand upon its own merits, only remarking, that the veracity of the gentleman, to whom the declaration was made, is not to be doubted.

Von Kempelen has been dead about twenty years: he had repeatedly offered his machine to Mr. Maelzel; but demanded 20,000 francs

for it, which was thought too much, and the bargain was consequently not made. About two years after the death of Kempelen, his son renewed the offer, and proposed to take one half the sum demanded by his father, to which Mr. Maelzel agreed, and the figure was removed from the garret, where it had lain for about twenty years. With the machine, the secret of its use was not given, as it had not been entrusted by Von Kempelen to his son; and the latter being a man of little talents, and having no fondness for mechanics, had not troubled himself upon the subject; but Mr. Maelzel, possessed of the machine, of course found no difficulty in discovering the mode of using it. He, however, thought it capable of considerable improvement, and determined to make several alterations, calculated to render its action, of more difficult explanation. This gentleman allowed about ten years to elapse before he commenced exhibiting the chess player, publicly; he had then made the alterations which he had projected, but had not however, added to it the speaking apparatus; the figure merely shaking its head twice when it checked the queen, and three times when it gave check to the king, as it had been made to do by Von Kempelen. Mr. Maelzel had already constructed and exhibited some speaking figures, and, whilst in London, some gentlemen suggested that it would be an improvement to make the Turk say *check*, and this alteration was consequently made in that city. On visiting Paris, the French work *echec* was substituted, and has been continued in this country.

The above account, will, we think, remove much of the difficulty which has been urged, as regards the number of persons to whom the secret, relating to the chess player, must have been entrusted, since the formation of the machine. It has been in the hands of but two persons, and has been off the stage for upwards of half the time which has elapsed since its first exhibition. Von Kempelen was, evidently, not very communicative upon the subject, as his son and heir, had not become his confidant. There are but few persons, however, who might not be trusted, were a considerable pecuniary interest, at stake.

Besides the chess player, Mr. Maelzel exhibits some other figures, which possess unusual merit. By moving the arm, one of them is made to pronounce the word *Mama*, with great distinctness, and the word *Papa*, is also tolerably well uttered. One of his slack-rope dancers, uses a French exclamation, the sound being elicited by the motion of the limbs. In these there is no confederacy, the sounds are mechanically produced, and are highly imitative: the attempts to accomplish such imitations have frequently baffled the skill of the most ingenious mechanicians. We had rather undertake to make the chess player, than one of the speaking figures, although the *labour* of the latter undertaking, would not be comparable with that of the former, so far as mere quantity of work is concerned. The evolutions of the figures upon the slack-rope, are admirably managed, very much surpassing, in merit, all that we have heretofore seen. The Automaton Trumpeter, a figure the size of life, performs a variety of airs, with the most perfect truth, and brilliant execution. The Editor has ex-

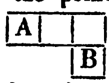
amined the mechanism of this figure, having been allowed so to do, by the liberality of the proprietor.

Mr. Maelzel has been for many years distinguished for his great mechanical skill. The Panharmonicon, which was formerly exhibited here, was made by him: he is likewise the inventor of the Metronome, an instrument by which the time in music is accurately measured; it is not unknown here, and is extensively used in Europe. He has also invented, an apparatus which is attached to a Piano Forte, by which any piece of music which is played on it, is at the same time correctly written out. His speaking figures are of his own make, and far excel the attempts of Von Kempelen, although the labours of the latter, were eminently successful.

The haste with which the foregoing remarks have been written, has prevented that arrangement which would have been observed under other circumstances; as an apology for this defect, we need only to state the fact, that the sheets were sent to the printer, in succession, as they were written; which was necessary, in order to their appearance in the present number of the journal.

The Knight's move in the Game of Chess.

BY THE EDITOR.

One part of the performance of the chess-player of Von Kempelen, consists in his covering, by the successive moves of a knight, every square upon the board, without touching either of them a second time. Many of our readers know the nature of this move, but for the sake of those who do not, we will observe, that it is made in a diagonal line, passing to the third square from the point of starting, in the manner represented in this figure, 

where one letter may represent the starting point, and the other, the square on to which the move is made; it will be seen that in every move, the colour of the square is changed. These moves may be very readily traced, by examining the numbers on the squares of the succeeding diagrams.

Several men of great celebrity have investigated the mode of doing this. Among them we find the names of Montmort, De Moivre, and De Mairan; each of whom has given a solution; but in each of their methods, some particular square is designated, from which the first move is to be made; the knight may not be placed upon any square upon the board, indifferently. The Automaton chess player, however, performs the circuit, commencing at any part of the board. The method by which this is accomplished was discovered by a gentleman who is not named, excepting as M. De W * * *, a captain in the Russian service. The following are the methods of De Moivre, and of M. De W * * *.

By De Moivre.

34	49	22	11	36	39	24	1
21	10	35	50	23	12	37	40
48	33	62	57	38	25	2	13
9	20	51	54	63	60	41	26
32	47	58	61	56	53	14	3
19	8	55	52	59	64	27	42
46	31	6	17	44	29	4	15
7	18	45	30	5	16	43	28

By M. De W * * *.

25	22	37	8	35	20	47	6
38	9	24	21	52	7	34	19
23	26	11	36	59	48	5	46
10	39	62	51	56	53	18	33
27	12	55	58	49	60	45	4
40	63	50	61	54	57	32	17
13	28	1	42	15	30	3	44
64	41	14	29	2	43	16	31

The first of these methods, may be more easily remembered than any other which has been given; as all the squares in the two outer rows, are first to be filled, excepting when a point is attained, which is not within reach of a blank on either of them, the third row must then be entered; but from this, we immediately repass to the two outer rows, until they are all filled. The same rule is observed as we approach the centre, never filling a square upon an inner, when a move can be made to an outer row. A little practice, will render this quite easy. A counter, or a piece of paper, should be placed upon each square as it is touched.

In the method of M. De W * * *, no general rule can be given for assisting the memory, and it consequently requires considerable practice; but when once attained, the moves are invariable, as they bear

some resemblance to a journey round a circle, which is still the same, at whatever point it is commenced. To accomplish this, it was necessary, that the last square reached, should be exactly a knight's move from the starting point, as may be seen on the squares 1 and 64, on the diagram.

A little consideration will render it evident, that we may designate any square we please, as No. 1, provided, the numbers occupying the other squares in the diagram, be changed in the same proportion. An example will make this clear. We will fix upon No. 6, on the right hand corner of the upper row; to reduce this to No. 1, we substract 5 from it, and we must proceed to do the same with every other number, excepting where such number is less than the subtrahend, in which case it must be added to 64, and the subtrahend taken from their sum; the first column will then be changed from 6, 19, 46, 33, 4, 17, 44, 31, to 1, 14, 41, 28, 63, 12, 39, 26, the 4 is here changed into 63, because $4+64-5=63$. The whole board will then stand thus:

20	17	32	3	30	15	42	1
33	4	19	16	47	2	29	14
18	21	6	31	54	43	64	41
5	34	57	46	51	48	13	28
22	7	50	53	44	55	40	63
35	58	45	56	49	52	27	12
8	23	60	37	10	25	62	39
59	36	9	24	61	38	11	26

Although the numbers are here changed, the succession remains the same, and Nos. 1 and 64, are still a knight's move from each other. Another, and a more easy mode of changing this arrangement, is to begin at any number fixed upon, say for example, No. 30; from this pass regularly on to No. 64, and from that to No. 1, 2, 3, &c. up to 29, which will complete the circuit. The above rules are given to exemplify the *nature* of the arrangement, by which the end proposed, is attained.

Duck Shooting.

An article under the above title has been lately going the rounds of the Newspapers, the particular object of which is to make known the method pursued in decoying, and shooting, the canvas-back Duck, on the shores of the Susquehannah. We extract from Wilson's Or-

nithology, the account of *tolling in*, together with some other information respecting them, as given by him, written in his usual pleasing style, and containing at the same time, a more concise, and far more correct detail, than the account of "A Sportsman."

It has recently been announced, as a novelty, that canvas-backs have been shot on the Delaware, a few miles below this city; this *novelty* was published in the Ornithology twelve years ago, and had been then long known to naturalists and to sportsmen.

The Canvas-back Duck.

Extracted from Wilson's Ornithology, Vol. 8, p. 104.

"The canvas-back Duck arrives in the United States, from the north, about the middle of October; a few descend to the Hudson and Delaware, but the great body of these birds resort to the numerous rivers belonging to, and in the neighbourhood of the Chesapeake Bay; particularly the Susquehannah, the Patapsco, Potomac, and James' rivers, which appear to be their general winter rendezvous. Beyond this to the south, I can find no certain accounts of them. At the Susquehannah, they are called *Canvas-backs;* on the Potomac, *White-backs;* and on James' river, *Sheldrakes.* They are seldom found at a great distance up any of these rivers, or even in the salt-water bay; but in that particular part of tide-water where a certain grass-like plant grows, on the roots of which they feed. This plant, which is said to be a species of Valisineria, grows on fresh-water shoals of from seven to nine feet, (but never where these are occasionally dry,) in long, narrow, grass-like blades, of four or five feet in length; the root is white, and has some resemblance to small celery. This grass is, in many places, so thick that it is with difficulty a boat can be rowed through it, it so impedes the oars. The shores are lined with large quantities of it, torn up by the ducks, and drifted up by the winds, lying like hay, in wind-rows. Wherever this plant grows in abundance, the Canvas-backs may be expected, either to pay occasional visits, or to make it their regular residence during the winter. It occurs in some parts of the Hudson, in the Delaware, near Gloucester, a few miles below Philadelphia, and in most of the rivers that fall into the Chesapeake, to each of which particular places these ducks resort; while in waters unprovided with this nutritive plant, they are altogether unknown.

"On the first arrival of these birds in the Susquehannah, near Havre-de-Grace, they are generally lean; but such is the abundance of their favourite food, that towards the beginning of November, they are in pretty good order. They are excellent divers, and swim with great speed and agility. They sometimes assemble in such multitudes as to cover several acres of the river, and when they rise suddenly, produce a noise resembling thunder. They float about these shoals, diving and tearing up the grass by the roots, which is the only part of it they eat. They are extremely shy, and can rarely be approached, unless by stratagem. When wounded in the wing, they dive to such prodigious distances, and with such rapidity, continuing

it so perseveringly, and with such cunning and active vigour, as almost always to render the pursuit of them hopeless. From the great demand for these ducks, and the high price they uniformly bring in market, various modes are practised to get within gun-shot of them. The most successful way is said to be, decoying them to the shore by means of a dog, while the gunner lies closely concealed in a proper situation. The dog, if properly trained, plays backwards and forwards along the margin of the water; and the ducks, observing his manœuvres, enticed perhaps by curiosity, gradually approach the shore, until they are sometimes within twenty or thirty yards of the spot where the gunner lies concealed, and from which he rakes them, first on the water, and then as they rise. This method is called *tolling them in.* If the ducks seem difficult to decoy, any glaring object, such as a red handkerchief, is fixed round the dog's middle, or to his tail, and this rarely fails to attract them. Sometimes by moonlight the sportsman directs his skiff towards a flock, whose position he had previously ascertained, keeping within the projecting shadow of some wood, bank, or headland, and paddles along, so silently and imperceptibly, as often to approach within fifteen or twenty yards of a flock of many thousands, among whom he generally makes great slaughter.

"Many other stratagems are practised, and indeed every plan that the ingenuity of the experienced sportsman can suggest, to approach within gun-shot of these birds; but of all the modes pursued, none intimidates them so much as shooting them by night; and they soon abandon the place where they have been thus repeatedly shot at. During the day they are dispersed about; but towards evening collect in large flocks, and come into the mouths of creeks, where they often ride as at anchor, with their head under their wing, asleep, there being always centinels awake, ready to raise an alarm, on the least appearance of danger. Even when feeding, and diving in small parties, the whole never go down at one time, but some are still left above, on the look out.

"When the winter sets in severely, and the river is frozen, the Canvas-backs retreat to its confluence with the bay, occasionally frequenting air holes in the ice, which are sometimes made for the purpose, immediately above their favourite grass, to entice them within gun-shot of the hut, or bush, which is usually fixed at a proper distance, and where the gunner lies concealed, ready to take advantage of their distress. A Mr. Hill, who lives near James' river, at a place called Herring creek, informs me, that one severe winter, he and another person broke a hole in the ice, about twenty by forty feet, immediately over a shoal of grass, and took their stand on the shore in a hut of brush, each having three guns, well loaded with large shot. The ducks, which were flying up and down the river in great extremity, soon crowded to this place, so that the whole open space was not only covered with them, but vast numbers stood on the ice around it. They had three rounds, firing both at once, and picked up eighty-eight Canvas-backs, and might have collected more, had they been able to get to the extremity of the ice, after the wounded ones."

Ale and Porter Preserver.

In order to preserve ale or porter in good condition, for a considerable length of time, it is generally kept in bottles; and though the method of bottling does sufficiently well, yet Mr. Donovan remarks, it is subject to this inconvenience; that in cases where a small quantity, as one draft is wanted, all the rest of the ale in the bottle goes to waste, unless very small bottles be used, which would be expensive and inconvenient. Mr. Donovan concludes, that pressure is the secret cause of ale, &c. keeping so well in bottles; and, therefore, he has contrived an apparatus, by which the liquids may be constantly under pressure in casks, as well as in corked bottles. He has a vessel made in the form of a cask, of strong tin, strongly hooped; it stands on its end. At the upper end is a cock, soldered to a tube, which is immersed to within an inch of the bottom of the cask. At the same end is a condensing syringe, by means of which, air can be forced into the cask; and whenever this is done, it is obvious, that the liquor will have a tendency to escape through the tube, and out at the cock, with a force proportioned to the degree the air is compressed by the action of the syringe. If the cock be now turned, the ale rushes out with violence, forming, at the same time, a great quantity of froth, or what is called a creamy head. In this case it will be evident, that every time ale is drawn from the cask, the air it contains is not exposed to the atmosphere, the liquor is kept under pressure, no vent peg is necessary, and Mr. Donovan states, that the ale will come up sprightly and good, with a dense creamy head, to the last. In short, all the advantages of bottling will be obtained, without the disadvantage of sacrificing a whole bottle, when no more than a small quantity is required.

Remarks by the Editor.—In the year 1810, Dr. Robert Hare invented a cask for the purpose of preserving fermented liquors from the deteriorating effects of atmospheric air; and to cause them to rise by the elasticity of the fixed air, which is disengaged from them, and which, in ordinary casks, finds its way, gradually, through the pores of the wood. These casks were made of oak, and, in some instances, headed with cast iron; they were strongly hooped, were small in diameter, and the wood was saturated with oil and wax, so as to fill the pores, and render the barrels completely impervious to air. They were furnished with a tube, similar to that above described, which is analogous to those used in mineral water cisterns. These barrels were capable of sustaining an immense pressure; this is not the case with vessels made of tin, which must, in warm weather particularly, be liable to burst by the elasticity of the disengaged air.

Dr. Hare also used the forcing syringe, knowing that the quantity of atmospheric air to be forced in, would be insufficient to produce acidity. There is, however, a strong objection to the use of such vessels, because, simple as they appear to some individuals, most persons find a difficulty in managing them, and prefer the ordinary and more simple mode of procedure.

Model of a Steam Carriage.

The Reading-room of the Mechanics' Institute, in Hull, England, was crowded, in November last, to witness the exhibition of a model of a steam carriage to run on common roads. This machine weighs eighty-two ounces, is eleven inches in length, has three wheels, and is guided by a lever in front. The boiler and engine are placed in the hinder part of the carriage; the steam cylinder is half an inch bore; and the stroke of the piston is seven-eighths of an inch. The eighth part of a pint of water being put into the boiler, (which is heated by a tallow lamp,) causes it to go for the space of half an hour. It will turn in a circle, the diameter of which is only twice the length of the carriage, and the inner wheel will form the centre of its motion. It is capable of being backed in a moment with the greatest ease, and when allowed to run in a straight direction, at its greatest speed, will proceed at the rate of upwards of five miles per hour. The youthful inventor is a clerk, and the machine is the production of his leisure hours.

Remarks by the Editor.—Scarcely a week passes without some public notice of a *New Steam Engine*, which is to produce a mighty revolution in the structure, and the use, of that instrument; this notice goes the rounds in the newspapers, and, in the greater number of instances, we hear no more of the invention. But few of those persons who propose improvements in the Steam Engine, are intimately acquainted with the principles concerned in its action, and its application; and a still smaller number, know the history of what has been heretofore attempted with regard to it. The consequence is, that the first imperfect machines are reinvented, and brought forth as novelties and improvements. In the above instance, we think that the young gentleman who made the model in question, has employed his leisure hours in a way which entitles him to much praise; and have no doubt that he has manifested great ingenuity and skill; but we apprehend that the running of his model upon the table, or floor, will not serve to prove that a large carriage, made upon the same principle, would "run, on common roads." We are sorry when we see young men of evident talents, making a public parade upon such a subject, as we believe such parade is likely to be the precursor of disappointment and mortification.

Description of the Chain Bridge over the Straits of Menai, North Wales.

The following description of the stupendous chain bridge in North Wales, is furnished by a friend, who has lately received it in a letter from a gentleman now travelling in England.

"This stupendous structure, this miracle of art, this modern colossus, has alike excited the wonder of the vulgar, and called forth the admiration of the learned and scientific; and bids fair to stand for ages an amazing

monument of British ingenuity—nor could I but reflect, that when death shall deprive our country of the man whose consummate skill projected the work, he will have no need of any monument, for it is already erected over the straits of the Manai:—but I must apologise for this digression, as eulogy is but poor description. The morning being fine, I resolved to see the "Chain Bridge" before breakfast, and accordingly set out. On my way thither, I overtook a very intelligent man, whom I found, after a little conversation, to be one of the under engineers, and to whom I owe my information, as to the principles and admeasurements of it.

"On account of the hilly nature of the ground on each side of the straits, piers of granite are built on each side, which make the road level with the country. These piers, are built on arches of 52 feet span; from high water mark, to the spring of each arch, is 65 feet, and lead to the grand pillars from which the chains are suspended in massive, yet graceful festoons. These pillars tower 152 feet above high water mark: through them are gate ways which lead to the carriage roads, 9 feet wide, 15 high: there are two carriage roads, each 12 feet wide, and a foot path between them 3 feet wide.

"The chains, 16 in number, are 1714 feet in length, formed of links composed of five bars of wrought iron, 10 feet long, 3 inches deep, and ½ an inch thick; these five bars are put side by side, and riveted by bolts; forming an almost solid bar, of 10 feet long, 3 inches deep, and 2½ inches thick; of these links the chains are formed; four of which chains, form one great chain; and these four, are so suspended, that the middle of the upper links, fall on the joints of those underneath. This is a description of such links as hang from pillar to pillar, a distance of 553 feet; those from the pillars to the fastenings, are rather shorter, and thicker: I traced them to the rocks where they are fastened, and was truly surprised at the amazing strength and apparent security of the whole, and could not help questioning whether Jove's

> "——— everlasting chain,
> Whose strong embrace holds heaven, earth and main,

were half so well secured.

"In the saddles over which the chains pass on the tops of the pillars, rollers are placed, to prevent any accident happening from the contraction or extension of the iron work by heat or cold, as also from the heat or cold affecting either side, unequally.

"The vertical rods suspended from the chains are of iron, one inch square, and serve to support the sleepers on which the flooring of the road-way is laid, these rods are five feet asunder: a neat railing of about five feet high, runs along the whole line of the bridge."—*N. Y. Com. Adv.*

Cast Metal Pianos.

Every day the use of cast iron is becoming more general; bridges and steam-boats are made of it; in England it is used for roads; and at

Liverpool, churches are built of it. Here, in Paris, we have lately got Pianos, the frame-work of which is formed of cast iron. These instruments have been brought to such perfection, by MM. Pleyel and Company, that not only do they rival, but, in many particulars, surpass the best English instruments. The solidity of the frame-work is so great, that they seldom get out of tune, and the sound-board relieved from those enormous pieces of wood with which it was formerly cumbered, in order to resist the strain, possesses much more elasticity, and seconds the vibration of the strings, much better. The tone of these instruments is wonderful, both in power and mellowness; and the mechanism is so perfect, that it admits of the most delicate, as well as of the strongest touch. Indeed, we have no doubt that when they are known, they will put an end to the importation of foreign Pianos. MM. Pleyel and Co. have also just obtained a patent for square Pianos, with single strings.—*French paper.*

Chinese method of making Sheet-lead.—The sheet-lead which comes from China, is manufactured in a way not generally known in this country. The operation is conducted by two men. One is seated on the floor, with a large flat stone before him, and with a moveable flat stone-stand at his side. His fellow workman stands beside him with a crucible filled with melted lead, and having poured a certain quantity on the stone, the other lifts the moveable stone, and dashing it on the fluid lead, presses it out into a flat and thin plate, which he instantly removes from the stone. A second quantity of lead is poured in a similar manner, and a similar plate formed; the process being carried on with singular rapidity. The rough edges of the plates are then cut off, and they are soldered together for use.

Raining Trees.—In the ancient histories of travellers in America, and also by Thévet, in his Cosmographia, mention is made of a tree which attracted the clouds from the heavens, and converted them into rain in the dry deserts. These relations have been considered as fables. There has been lately found in Brazil, a tree, the young branches of which drop water, which falls almost like a shower. This tree, to which Leander has given the name of *Cubea Pluviosa,* is transferred by M. Decandolle to the genus *Cæsalpina.*

King of Portugal's Diamond.—From the following statement of the weight of the largest diamonds known in Europe, it will be seen that the King of Portugal possesses the very largest. The diamond of the Emperor of Russia weighs 106 carats;* that of the King of France, 136; that of the Grand Duke of Tuscany, 139; that of the Great Mogul, 279; that of the King of Persia, 493; that of the King of Portugal, 1610 carats. The value of this last is estimated, by the Portuguese jewellers, at 200,000,000 of pounds sterling; by the French jewellers, at 1200,000,000 of French livres; and by the English and Dutch jewellers, at 55,787,300 pounds sterling.—*Hamburgh paper.*

* A carat is about four grains.

Spinning Flax.—MUNICH.—One of the greatest difficulties in mechanics, and which was but imperfectly overcome, though great rewards were offered both by England and France, was to contrive a means of spinning flax like cotton. This problem has now been happily solved by M. Hofer, of Meram, in the Tyrol, who, having matured his ideas, came to Munich, and employed an able mechanician, M. Ertl, to make a machine according to his directions. In this he has fully succeeded, and M. Hofer has obtained a patent from his majesty, the king of Bavaria, and will solicit patents also from Austria and Prussia.

Large Steam Vessel.—One of the largest Steam vessels ever built in this country, has recently arrived in the Thames. It is intended to convey passengers from London to Edinburg, and to all the intervening ports at which she can conveniently touch. She is called "The United Kingdom," and has just finished an experimental trip round the north of Scotland, highly to the satisfaction of her owners, and a large party on board. She was built by Steel & Co. of Greenock, and Napier & Co. Engineers, of Glasgow. She is 1065 tons burthen, her length 175 feet, her breadth 45 feet—she has two Engines of 100 horse power each—and the number of beds for passengers 150. On her first trip, she ran the first 240 miles, with the wind unfavourable all the way, in 21 hours, and did 750 miles in 73 hours, including a number of stoppages. It is said that her Engines produce little or no noise, and that her interior embellishments are of a superb description.—*London paper.*

Gas Works.—A discovery of great importance has lately been made by Mr. Archibald Cook, manager of the Paisley Gas Works. The gas tar, which is of little value and troublesome to get quit of, Mr. Cook has applied as a substitute for coal, in heating the retorts, in the production of gas. The practical result of his experiment has been completely successful. The ingenious method by which this operation is conducted, is entirely new, and must produce the Paisley gas company, an annual saving of several hundred pounds, and to other establishments a greater, in proportion to their extent. Mr. C. has deservedly gained much credit by his exertions, in producing such improvements; and there is no doubt but that this discovery will soon be universally known, adopted, and duly appreciated.

Preservation of Apples.---The following observations contained in a letter from Noah Webster, Esq. have been published in the Massachusetts Agricultural Repository.

"It is the practice with some persons to pick apples in October, and first spread them on the floor of an upper room. This practice is said to render apples more durable by drying them. But I can affirm this to be a mistake. Apples after remaining as long on the trees as safety from the frost will admit, should be taken directly

from the trees, to close casks, and kept as dry as possible. If suffered to lie on the floor for weeks, they wither and lose their flavour, without acquiring any additional durability. The best mode of preserving apples for spring use, I have found to be, the putting them into dry sand as soon as picked. For this purpose I dry sand in the heat of the summer; and late in October, put down the apples in layers, with a covering of sand upon each layer. The singular advantages of this mode of treatment are these: 1st, the sand keeps the apples from the air, which is essential to their preservation. 2d, The sand checks the evaporation from the apples, and thus preserves their full flavour—at the same time any moisture yielded by the apples, (and some there will be) is absorbed by the sand; so that apples are kept dry, and all mustiness is prevented. My pippins, in May and June, are as fresh as when first picked; even the ends of the stem look as if just separated from the twig."

French Patents, 1826.

J. G. Ulrich, London, for his importation and improvements in the construction of chronometers. 5th May—15 years.

J. Despiau, Senr., Bordeaux, Department Gironde, for his invention of a machine to batt, open, and clean wool. 12th May—10 years.

J. M. Hanchett, and H. G. Smith, Paris, for improvements and additions to their patent of importation for an apparatus to compress gas. 1st July, 1824—15 years.

De Lamortiziere, Paris, for improvements and additions to his patent for a machine to drive boats up rivers. 17th March—10 years.

A. J. P. Thilorier, Paris, for his invention of a lamp he calls "hydrostatic." 12th May—5 years.

F. Rouard, Paris, for improvements and additions to his patent of invention for manufacturing of tiles to cover houses. 3d March—5 years.

P. N. Tastemain, Swonches, Department Eure et Loir, for his invention of a machine to cut the corn in the field. 12th May—15 years.

T. H. Pape, Paris, for his improvements in the construction of Piano-fortes. 12th May—10 years.

Madame Regnauld, Paris, for her invention of a "pectoral paste." 19th May—15 years.

Norbert Rillieux, Paris, for his invention to obtain hydro-carbonic gas, at different degrees of pressure. 19th May—10 years.

J. B. D. Perot, Paris, for his invention of a process and means to mark the points at card playing, or other games. 19th May—5 years.

C. Guigo, Lyons, Department Rhone, for his invention of a machine to weave, &c. 19th May—10 years.

P. M. Daulle, and L. J. Cordier, Paris, for their importation of a machine to prepare wool, silk, &c. 19th May—5 years.

P. Tremblot Lacroix, Paris, for his invention of a machine he calls "compositor typographic." 2d June—5 years.

J. J. Burle, Paris, for his invention of a composition of platine. 2d June—5 years.

H. Langlois, Paris, for his invention of a cock applicable to machines containing gas. 2d June—5 years.

P. Tespar, Paris, for his invention and improvement of an apparatus he calls "Fumivore vaporator et condenzator." 2d June—10 years.

Fehr, et Vic-dezsos, Department Arriege, for his invention of vessels or pots to manufacture mineral, vegetable, or animal coal. 2d June—10 years.

G. W. Walker, Lorint, for his invention of a loco-motive carriage. 2d June—10 years.

A. Christofle, Junr., Paris, for his importation and improvement in the manufacturing of buttons from tortoise-shell, bone, &c. 2d June —5 years.

J. Rocher, Paris, for his invention of a wheel to regulate the emission of portable gas. 2d June—15 years.

Maillard-Durneite, Paris, for his invention of a cylindrical distilling apparatus. 2d June—10 years.

P. Raviers, Paris, for his invention and improvements of a composition he calls "ladies' coffee." 2d June—10 years.

J. D. Fisher, Paris, for his invention, importation, and improvement of a set of machinery, to card, prepare, and spin wool, and other fibrous materials. 9th June—15 years.

M. J. A. Comoy, Nevers, Department Nievre, for his invention of a new wine press. 9th June—5 years.

P. E. Kinkelin, Paris, for his invention of a process to anchor boats on navigable rivers. 9th June—5 years.

LIST OF PATENTS IN ENGLAND,

Which have passed the Great Seal since August 22d, 1826.

To John Charles Schwieso, musical instrument maker, for his invention of improvements on certain stringed musical instruments—Sealed 22d August.

To Timothy Burstall, of Leith, Scotland, and John Hill, of Bath, engineers, for their invention of certain improvements in the machinery for propelling locomotive carriages—22d August.

To James Yandall, private person, for improvements on apparatus for cooling and heating fluids—24th August.

To Francis Halliday, Esq. for his invention of certain improvements in raising or forcing water—24th August.

To William Downe, plumber and brass-founder, for his invention of certain improvements on water closets—25th August.

To Robert Busk, and William King Westly, flax-spinners, for their invention of certain improvements in machinery for flecking, or dressing, and for breaking, scutching, or cleansing hemp, flax, or other fibrous substances—29th August.

To William Day, trunk and camp equipage maker, for his inven-tion of certain improvements on bedsteads, which improvements are also applicable to other purposes—31st August.

To Thomas Robinson Williams, Gent. for his having invented or discovered a machine for separating burs or other substances, from wool, hair, or fur—18th September.

The same, for an improved method of manufacturing hats and caps with the assistance of machinery; 18th September.

To John Riste, lace manufacturer, for his invention of certain improvements in machinery for making net commonly called bobbin or twist net—4th October.

To Francis Halliday, Esq. for his invention of certain improvements on apparatus used in drawing boots on, and off—4th October.

To Theodore Jones, accountant, for his having found out and invented improvements on wheels for Carriages—11th October.

To William Mills, gentleman, for his invention of improvements in fire-arms—18th October.

To William Church, Esq. for his invention of certain improvements in printing—18th October.

To Samuel Pratt, camp equipage manufacturer, in consequence of a communication from a Foreigner, resident abroad, and discoveries by himself, for an invention of certain improvements on beds, bedsteads, couches, seats, and other articles of furniture—18th October.

To William Busk, Esq. for his invention of certain improvements in propelling boats and ships, or other vessels, or floating bodies—18th October.

To James Viney, Colonel in our Royal Artillery, and George Pocock, gentleman, for their invention of certain improvements in the construction of cars and other carriages, and the application of a power, hitherto unused for that purpose, to draw the same; which power is also applicable to the drawing of ships, and other vessels, for raising weights, and for other useful purposes—18th October.

NOTICES.

The "Essays on Mathematics," commenced in the last number, will be either discontinued, or rewritten. Judging from the first essay, the Editor had determined upon the insertion of the series, but a further examination has proved that they are too defective, both in style and arrangement, for the pages of this Journal.

The inquiries made by an Alabama correspondent, shall receive due attention. The Editor is aware of the importance of the subject; and has taken measures to furnish full information, respecting it.

The length of several of the articles in the present number, has prevented that *variety*, in the subjects treated, which will generally mark our pages. The practical mechanic, need not fear that we will either forget, or neglect his interest, or his gratification.

Fig. 1.

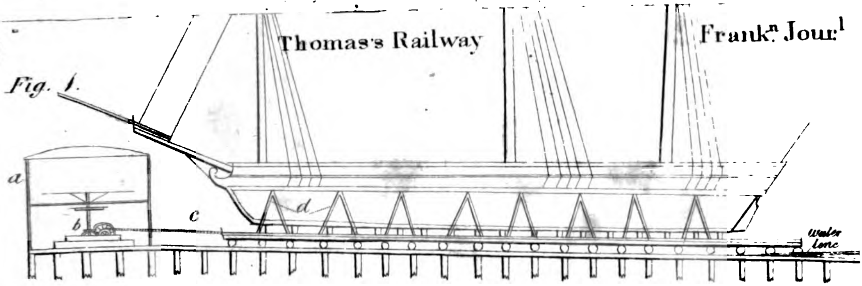


Fig. 2.

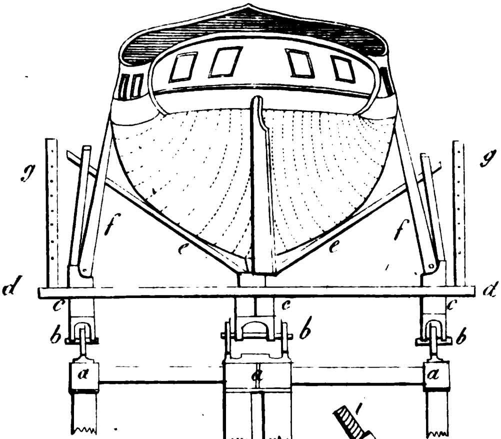
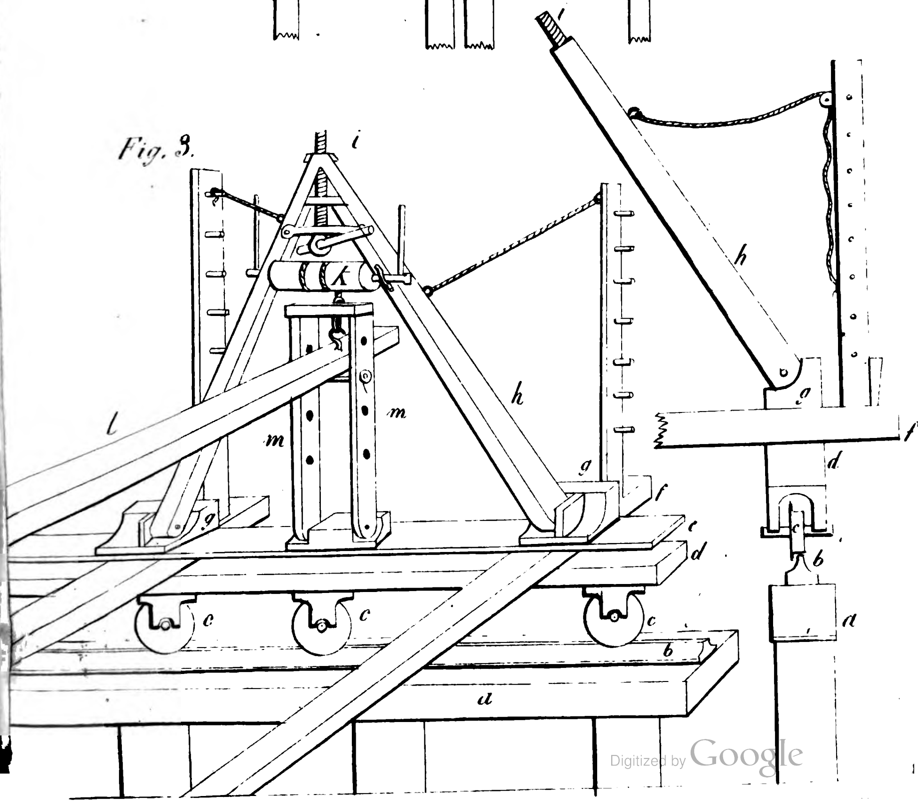


Fig. 3.



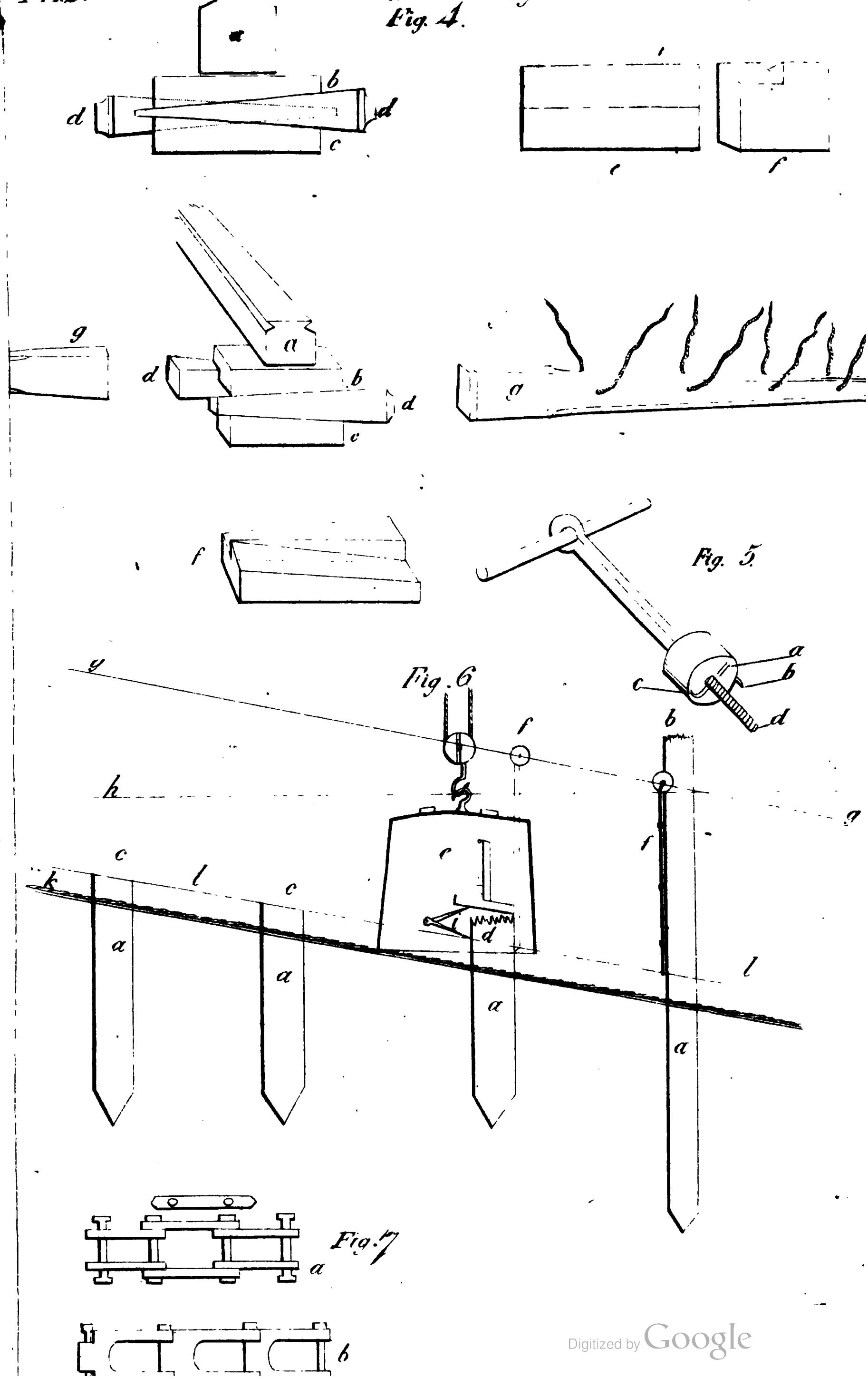


Fig. 4.
Fig. 5.
Fig. 6
Fig. 7

THE

FRANKLIN JOURNAL,

AND

AMERICAN MECHANICS' MAGAZINE;

DEVOTED TO THE USEFUL ARTS, INTERNAL IMPROVEMENTS, AND GENERAL SCIENCE.

MARCH, 1827.

ON THE NATURE AND PROPERTIES OF TIMBER.

Extracted from "The Elementary Principles of Carpentry. By Thomas Tredgold."

(Continued from p. 215, vol. ii.)

Prevention of Decay.

HAVING formerly noticed the chief causes of decay, in timber, its prevention becomes the next object of inquiry.

When timber has undergone a proper seasoning, in as far as regards the timber, it is the best means of securing it against decay, whatever may be the cause; and, in addition to what I have already said on seasoning (see No. 2. Vol. 2.) it only remains to add, that to be effectual, the seasoning must be complete. The time required for a complete seasoning, depends on the size of the pieces; and some correct experiments on this subject would be very desirable, if made on a large scale.

But however well timber may be seasoned, if it be employed in a damp situation, decay is the certain consequence; therefore, it is most desirable that the neighbourhood of buildings should be well drained, which would not only prevent the rot, but also increase, materially, the comfort of those who reside in them. The drains should be made water-tight wherever they come near to the walls; as walls, particularly brick walls, readily draw up moisture to a very considerable height. Earth should never be suffered to rest against walls, and the sunk stories of buildings should always be surrounded by an open area, so that the walls may not absorb moisture from the earth. To prevent moisture rising from the foundation, some substance that will not allow it to pass, should be used, at a course or two above the footings of the walls. Sheets of lead or copper have been used for that purpose. To

lay a few courses of slaty stones, that do not absorb much moisture, would be useful; but a better method is to build a few courses in height with Roman cement, instead of common mortar, and upon the upper course to lay a bed of cement, of about an inch in thickness. As moisture does not penetrate this cement, it is an excellent material for keeping out wet; and it is also a great improvement to a brick building, to stucco it on the outside with any cement that keeps out moisture, as brick absorbs quickly all the moisture that comes in contact with it, and retains it for a length of time.

The walls and principal timbers of a building should always be left for some time to dry after it is covered in. This drying is of the greatest benefit to the work, particularly the drying of the walls; and it also allows time for the timbers to get settled to their proper bearings, which prevents after settlements, and cracks in the finished plastering. It is sometimes thought that its usefulness arises from its allowing the timber more time to season; but when the carpenter considers that it is from the ends of the timber that much of its moisture evaporates, he will see the impropriety of leaving it to season after it is framed, and also the cause of framed timbers of unseasoned wood, failing at the joints sooner than in any other place. No parts of timbers require seasoning so much as those that are to be joined. Seasoning in the frame, is a fatal error in ship-building.

When the plastering is finished, a considerable time should also be allowed for the work to get dry again before the skirtings, the floors, and other joiners' work be fixed. Drying will be much accelerated by a free admission of air, particularly in favourable weather.

When a building is thoroughly dried at first, openings for the admission of fresh air are not necessary where the precautions against any new accessions of moisture have been effectual. Indeed such openings only afford harbour for vermin, as the current of air through them is very seldom capable of carrying off any considerable degree of moisture; for it is well known that air will not move in a horizontal direction without a more considerable change of density than can be obtained in such situations. The roof over the Egyptian Hall, in the Mansion House, London, has a space of two feet in depth all round it for the free circulation of air between the roof and ceiling; and in old Gothic buildings the roofs were generally well ventilated, which must have added much to their durability. But the construction of floors does not admit of the same facilities, and therefore floors are more subject to decay; for, as Mr. Papworth very justly observes, "should the air absorb less moisture from the fungus, than the timber affords to its vegetation, the air will then increase the disease, and draw into fuller growth the fungus it has not the power to destroy; but if dry air be admitted in a quantity adequate to cause that absorption, it will necessarily exhaust and destroy the fungus." But such a quantity of dry air cannot, from the nature of the structure, be made to pass between the timbers of a floor, though sufficient may be admitted to accelerate its decay.

In floors next the ground, we cannot easily prevent the access of damp, but this should be done as far as possible. All vegetable mould

should be carefully removed, and if the situation admits of it, a considerable thickness of dry materials, such as brick-bats, dry ashes, &c. but not lime, should be laid under the floor, and over these, a coat of smiths' ashes, or of pyrites, where they can be procured. The timber for the joists should be well seasoned; and it is adviseable to cut off all connexion between wooden ground floors, and the rest of the wood-work of the building.

It is generally imagined that timber may be secured against the rot by impregnating it with substances that resist putrefaction; this opinion has produced many schemes, but no rational hopes of success can be entertained, unless the timber be also well seasoned, and secured as far as possible against moisture. No quick process is likely to succeed, yet something might be done, where time assisted, in giving permanence to the combination.

Common salt (muriate of soda) is found to protect the timber impregnated with it when the proportion of salt is considerable. The large wooden props which support the roofs of the salt mines in Hungary, and are perpetually moistened with salt water trickling down them, are said to have suffered no decay for many centuries; and the incrustations of salt upon the timbers of vessels employed in carrying salt-fish preserve them a great number of years. There are, however, strong objections to using solutions of salt, unless it be where it is of no importance whether the wood be dry or wet; for the attraction of salt for moisture would keep the wood continually wet, if moisture should be present.

Sea water has been found effectual in clearing timber of fungus, by immersing it for several months. A ship called the Eden was cleared of every trace of fungus by remaining eighteen months under water. But unless a solution of salt, so strong as to be objectionable from its attraction of water, could be used, there appears to be no well-grounded hope of its being useful; as it is well known that common salt in small quantities assists the decomposition of vegetable matter.

Sulphate of iron (commonly called green copperas) appears to be more likely to answer the purpose. Wood boiled for three or four hours in a solution of sulphate of iron, and then kept some days in a warm place to dry, becomes so hard and compact that moisture cannot penetrate it. In the Swedish Transactions it is recommended for preserving the wood of wheel carriages from decay; and Mr. Chapman observes, that the wooden vessels in which copperas is crystallized become exceedingly hard, and not subject to decay. Mr. Chapman strongly recommends immersing timber in a solution of this salt on a large scale, in order to be used for ship-building.

Dr. Darwin supposes that the rot in wood might be entirely prevented by soaking dry timber first in lime water, till it has absorbed as much of it as may be, and then, after it is dry, by soaking it in a weak solution of sulphuric acid in water. The acid will combine with the lime in the pores of the timber, and form gypsum (sulphate of lime) and preserve it from decay if kept dry. The benefit perhaps would not be equivalent to the trouble of this process.

Boiling in alkalies has been proposed; but as the alkalies dissolve and decompose the woody fibre, this process cannot be attended with advantage.

Quicklime, I have already stated, assists putrefaction when aided by moisture. But where a great quantity of quicklime is present, so as to preserve the wood, by its absorption of water, in a perfectly dry state, it hardens the sap, and renders the wood very durable. Of this effect of lime Mr. Chapman had an opportunity of seeing proofs in the vessels employed in the Sunderland lime trade, some of which were forty years old, and very sound.

Repairs of Buildings affected with the Rot.

To cure the rot is very difficult, and would be nearly, if not quite, as expensive a process as to put in anew the timbers affected with it; but when new timber is put in, the old parts and the walls should have every particle of fungus removed from them, or killed by some wash for that purpose. External washes perhaps are not much further useful than so far as they hinder infection; but to produce that effect they are perhaps the best application, because they can be applied with safety. A high degree of heat would destroy all power of reproduction, but it cannot so well be applied; nevertheless, where pieces of wood are not materially injured by the rot, to expose them to a strong heat would destroy all vegetable life in the fungus, and they might then be washed with some of the solutions mentioned below, and used again with perfect safety.

A solution of corrosive sublimate (corrosive muriate of mercury) would answer very effectually as a wash. It was proposed by Sir H. Davy. A very weak solution does not produce the desired effect; Chapman says there should be an ounce of corrosive sublimate to a gallon of water, and it should be laid on, hot. No other metallic solution should be mixed with it.

A solution of sulphate of copper (commonly called blue vitriol) in the proportion of about half a pound of sulphate of copper to one gallon of water, used hot, makes an excellent wash; and is cheaper than the preceding one.

A strong solution of sulphate of iron is sometimes used, but is not so effectual as that of copper; and sometimes a mixture of the two solutions has been used.

Coal tar is said to have been found beneficial, but its strong smell is a great objection to its use; where the smell is not of importance, it would assist in securing new timber that had been previously well dried.

Charring new wood can only be expected to prevent infection, as we have seen that decay may begin at the centre, and proceed without ever appearing at the surface of the beam; and therefore if timber be not well seasoned, no permanent good can be obtained from charring.

To preserve Wood exposed to the Weather.

When timber is exposed to the alternate action of dryness and moisture, the best means of securing the timber from moisture is the

protection of the surface by a coat of some substance that moisture will not penetrate.

The Dutch, for the preservation of their gates, drawbridges, sluices, and other large works of timber, that are exposed to the sun and perpetual injuries of the weather, coat them with a mixture of pitch and tar, upon which they strew small pieces of cockle and other shells, beaten almost to powder, and mingled with sea sand, or the scales of iron beaten small and sifted, which protects them in a most excellent manner.

Upon common painting, sanding is an excellent practice, where it is exposed to the weather; as I have uniformly observed sanded painting to be much more durable than common painting.

Mr. Chapman proposes a composition which possesses the properties of impenetrability to moisture, and flexibility. It consists in applying a paint made of sub-sulphate of iron (the refuse of the copperas pans) ground up with any cheap oil, and rendered thin with coal-tar oil, in which a little pitch had been dissolved. In the neighbourhood of copperas manufactories, the refuse of the copperas pans may be easily procured.

Another method of protecting timber is described by Mr. Semple, which appears to be so well calculated for the purpose, that in cases where it can be applied, a better cannot be employed. It is described in his own words as follows: "After your work is tried up, or even put together, lay it on the ground with stones or bricks under it to about a foot high, and burn wood (which is the best firing for that purpose) under it till you thoroughly heat, and even scorch it all over; then, whilst the wood is hot, rub it over plentifully with linseed oil and tar, in equal parts, and well boiled together, and let it be kept boiling whilst you are using it; and this will immediately strike and sink (if the wood be tolerably seasoned) one inch or more into the wood, close all the pores, and make it become exceeding hard and durable, either under or over water."

No composition should however be applied till the timber has been well seasoned, as to inclose the natural juices of the wood is to render its rapid decay certain.

[TO BE CONTINUED.]

On the mechanical formation of Roads.

[FROM PARTINGTON'S MECHANICS' GALLERY.]

THE only strongly marked division of the different kinds of roads depends on their being paved or gravelled; but each of these classes admits of considerable diversity in the principles on which the road is constructed. The theory of pavement appears to be extremely simple; the stones, however, may be either small or large; the former being understood to be employed without previous preparation of their shape, as in the inferior kind of work which is called "pitching," in

the west of England; the latter being more or less cut to fit each other, whether in the form of thick rough blocks, not very remote from cubes, or of flat and smooth flagstones: in the cities of Great Britain, the former are commonly used for horse pavements, and the latter for foot passengers; but in Florence the whole breadth of the streets is paved with flagstones placed diagonally, and in Naples the surfaces are nearly as smooth; in both these cases, it is necessary to roughen the stones frequently with chisels wherever there is a hill or a bridge, in order to prevent the horses slipping; but in both cities, the horses from habit are sufficiently sure-footed, even when running with some rapidity. In Milan both kinds of pavements are mixed in the same streets; the smooth in two double lines for the wheels of carriages coming and going, and the rougher in the intermediate parts, for the feet of the horses, as in the British rail-roads. But in none of these cities is there much heavy traffic to wear these well arranged surfaces into such inequalities as would probably soon be observed in the streets of London, if they were so delicately formed; although, until this deterioration actually took place, the locomotion would be luxurious both for the horses and for the passengers, and only ruinous to the coachmakers. The Romans used large and heavy blocks for their roads, cutting them on the spot into such forms as enabled them to be best adjusted to those of the neighbouring stones, though seldom exactly rectangular in their surfaces; and even at Pompeii, where the ruts are worn half through the depth of the blocks, the bottom remains tolerably even, in a longitudinal direction, at least as much so as would be required for carts and other carriages of business.

Our more particular object, however, at present, is the consideration of gravel roads, rather than of pavements; the word gravel being here understood to mean in general all stone broken small, whether by nature or by art. The improvement of such roads has long been a subject of great interest with the agricultural and commercial inhabitants of Great Britain.

But all other improvements, whether real or imaginary, have of late been in a great measure superseded by the ingenuity and success of Mr. Loudon MacAdam, a gentleman whose practice is in general principally to be applauded for its obvious simplicity and economy, though he has also had the merit of discovering that the simplest and cheapest methods, in particular cases, especially in that of boggy soils, are also the most scientific and the most effectual. The practical observations, which are to be here inserted, cannot therefore be so well expressed in any other form, as in that of an abstract of Mr. MacAdam's own directions.

Mr. MacAdam's leading "principles are," (*Remarks*, p. 37,) "that a road ought to be considered as an artificial flooring, forming a strong, smooth, solid surface, at once capable of carrying great weights, and over which carriages may pass without meeting any impediment."

He proceeds to give directions for repairing an old road, and for making a new one, in the form of a communication to a Committee appointed by the House of Commons, in the year 1819, with some subsequent corrections.

No additional materials, he observes, are to be brought upon a road, unless in any part of it there be not a quantity of clean stone, equal to ten inches in thickness.

The stone already in the road, supposing it to have been made in the usual manner, is to be loosened and broken, so that no piece may exceed six ounces in weight; the road is then to be laid as flat as possible, leaving only a fall of three inches from the middle to the sides, when the road is thirty feet wide. The stones, thus loosened, are to be dragged to the side by a strong heavy rake, with teeth two inches and a half in length, and there broken; but the stones are never to be broken on the road itself.

When the great stones have been removed, and none are left exceeding six ounces in weight, the surface is to be made smooth by a rake, which will also settle the remaining materials into a better consistence, bringing up the stone, and letting the dirt fall down into its place.

The road being so prepared, the stone that has been broken by the side, is then to be carefully spread over it; this operation requires very particular attention, and the future quality of the road will greatly depend on the manner in which it is performed; the stone must not be laid on in shovels full, but scattered over the surface, one shovel full following another, and being spread over a considerable space.

Only a small part of the length of the road should be prepared in this manner at once; that is, about two or three yards; five men in a gang should be employed to prepare it all across, two continually digging up and raking off the large stones, and preparing the road for receiving them again, and the other three breaking them at the side of the road. It may, however, happen, that the surveyor may see cause to distribute the labour in a proportion somewhat different.

The only proper method of breaking stones, in general, both for effect and for economy, is in a sitting posture. The stones are to be placed in small heaps, and women, boys, and old men past hard labour, may sit down and break them with small hammers into pieces not exceeding six ounces in weight. When the heavy work of a quarry can be performed by men, and the lighter by their wives and children, the stone can be obtained by contract for two-thirds of the former prices, although the stones were then left four times as large. It has also been recommended by Mr. MacAdam and others, that the largest stone employed should not exceed the measure of an inch in its greatest dimensions, or in other words, that it should be capable of being contained in a sphere of about an inch in diameter, which would seldom weigh more than a single ounce.

In some cases it would be unprofitable to prepare and relay a road, even if the materials should have been originally too large; for example, the road betwixt Bath and Cireneester was made of large stones, but so friable, that in lifting they would have fallen into sand; in this case, Mr. MacAdam merely had the higher parts cut down and replaced when sifted, and the surface kept smooth, until those materials were gradually worn out; and they were afterwards replaced by stone of a better quality, properly prepared. At Egham, it was necessary

to remove the whole road, in order to separate the small portion of valuable materials from the mass of soft matter in which they were enveloped, and which was carried away, at a considerable expense, before a good road could be made. But, although freestone is by no means calculated to make a durable road, yet, by judicious management, it may be made to form a very good road, as long as it lasts.

Whenever new stone is to be laid on a road already consolidated, the hardened surface is to be loosened with a pick, in order to enable the fresh materials to unite with the old.

A new road, however well it may have been made, will always receive the impressions of the carriage wheels, until it is hardened; a careful person must, therefore, attend the road for some time, in order to rake in the tracks made by the wheels; that is, as long as any loose materials are left that can be so employed.

It is always superfluous, and generally injurious, to add to the broken stone any mixture of earth, clay, chalk, or any other matter that will imbibe water, and be affected by frost; or to lay any thing whatever on the clean stone, for the purpose of binding it; for good stone, well broken, will always combine by its own roughness into a solid substance, with a smooth surface, that will not be affected by the vicissitudes of weather, or disfigured by the action of wheels, which, as they pass over it without a jolt, will consequently be incapable of doing it any considerable injury.

The tools required for preparing roads are,—1. Strong picks, but short from the handle to the points.—2. Small hammers, weighing about a pound, with a face the size of a shilling, well steeled, and with a short handle.—3. Rakes, with wooden heads, ten inches in length, and with iron teeth, about two and a half inches long, and very strong, for raking out the large stones when the road is broken up, and for keeping it smooth after it has been finished, and while it is consolidating.—4. Very light broad mouthed shovels, to spread the broken stones, and to form the road.

The whole expense of preparing and newly forming a rough road, to the depth of four inches, has generally been from a penny to twopence per square yard, being more or less according to the quantity of stone to be broken. With proper tools, and by proper arrangements, stone may be broken for tenpence or a shilling per ton, including, in some cases, the value of the stone itself. A very material advantage of Mr. MacAdam's method is the introduction of a much greater proportion of human labour, instead of the work of horses: formerly one-fourth of the whole expense was paid, in the district of Bristol, for men's labour, and three-fourths for that of horses: now, on the contrary, one-fourth only is paid for horses' labour, and the other three to men, women, and children.

Mr. MacAdam argues very strongly against the old opinion, of the necessity of placing a quantity of large stones, as a foundation, to carry the road over a wet subsoil. He says, that whatever be the nature of the soil, if it be previously "made quite dry," and a covering impenetrable to rain placed over it, the thickness of the covering needs only to depend on its own capability of becoming impervious.

Large stones, he says, will constantly work up by the agitation of the traffic on the road, and leave vacuities for the reception of water; and the only way of keeping the stones in their places, is to have them of a uniform size. A rocky bottom causes a road to wear out much faster (acting, probably, as a lower millstone in facilitating the operation of grinding.) "It is a known fact, that a road lasts much longer over a morass, than when made over rock. In the neighbourhood of Bridgewater, for example, the materials consumed on a rocky road, when compared with those which are required for a similar road made over the naked surface of the soil, are in the proportion of seven to five."

In the summer of 1819, upon some new roads made in Scotland, more than three feet of materials, of various dimensions, were laid down: and more than two-thirds of them, according to our author, were worse than wasted. In such an arrangement, the water generally penetrates to the bottom of the trench made to receive the road, and remains there to do mischief upon every change of weather.

To prevent this inconvenience, it is necessary, in wet soils, either to make drains, to lower the ground, or to raise the road above the general level, instead of making a trench to receive the stones; and from the penetration of rain, the solidity of the road itself must protect it. A well made road, not quite four inches in thickness, was found to have kept the earth below it dry, in the parish of Ashton, near Bristol: but six, eight, or ten inches of material are generally required to make a firm road; being laid on in successive layers of about two inches in thickness, all well broken, well cleaned, and well sized. Sometimes, indeed, a much greater depth of stone than this is required: in a road, for example, which has lately been made from Lewes to East Bourn, entirely upon Mr. MacAdam's principles, as much as three feet of materials was required in many parts before the road could be sufficiently consolidated: it has, however, ultimately been made excellent, though at an expense of not much less than a thousand pounds a mile.

Mr. MacAdam maintains that the quantity of stone required for paving is fully sufficient to make an excellent gravel road in any part of the world; and in almost every case, materials equally good can be obtained for roads at a much cheaper rate; commonly, indeed, at one-tenth of the expense of pavements. It is, however, in steep ascents that pavements are most objectionable; at the north end of Blackfriars Bridge, more horses are said to have fallen and received injury, prior to the late improvements, than at any other place in the kingdom. In the suburbs of Bristol the pavements have lately been converted into roads, with great success. It is probable that neither the inhabitants of these suburbs, nor the housemaids were much consulted on the occasion, although justice seems to require that the pedestrian order should not be altogether sacrificed to the equestrian, without their consent; but in fact, the inhabitants of these *ci-devant* streets are said to be well satisfied with the change; and we seem in danger, from the opposition of contending theories, of having all the streets of our cities dug up, and many of our country roads, on the other hand, encum-

bered with pavements. Mr. MacAdam has received a new encouragement from Parliament, to the amount of 4000*l*.; and not Charing Cross alone, but even St. James's Square, is now MacAdamised.

We find some further confirmations and illustrations of Mr. MacAdam's principles and precepts in the *Report* of the former Committee of the House of Commons, as reprinted in his *Remarks*.

This gentleman, it seems, arrived from America, in the year 1783, at the time that many new roads were making in Scotland; and he was then appointed a commissioner of the road, and studied the subject in that capacity there; he has since resided chiefly in Bristol, and was induced to take charge of the roads of that district as a surveyor, in 1816; because it was only in that situation that he could carry his principles into practice, and make the necessary experiments of establishing them. He observed in his travels, that the mixture of clay and chalk, with the materials of roads, was the almost universal cause of their failure; and he convinced himself that, by a proper application of materials, a good road might be made in every country. His improvements have been very generally adopted in the west and south of England; and principally under his own direction, or under that of his family. They had superintended more than 300 miles of road, and twice as many more had been improved by their advice and influence. Sober, active, and well informed subsurveyors he considers as the most important of all materials for a good road; and among the extrinsic arrangements which are often required, he thinks the union of different trusts into a single one, the most likely to be generally beneficial.

The operation of washing gravel, Mr. MacAdam has not found eligible, because it is more expensive than screening or sifting, and less effectual; about London the common gravel is not capable of being cleaned by any ordinary washing, though the Thames gravel, where it can be procured, is generally clean and serviceable. Coarse gravel, broken, he says, is preferable to fine, as it consolidates more perfectly into a single mass. The old practice of putting a heap of unprepared gravel along the middle of the road, and letting it work its own way gradually to the sides, he thinks every way reprehensible.

The objection to a very convex road is, that travellers only use the middle of it, which is, therefore, worn into three furrows by the string of horses, and by the wheels; if the road is flatter, it becomes worn more equally. Ditches, he observes, only require to be so deep that the surface of the water in them may be a few inches below the level of the road; the farmer often makes them dangerously deep on account of the value of the mould that is dug out of them. Mr. MacAdam would prefer a bog to any other foundation for a road, provided that it would allow a man to walk over it; and he justly observes, that the resistance to the motion of a carriage would not be materially affected by the foundation, if the road were well made. From Bridgewater to Cross, a part of the road shakes, when a carriage passes over it; yet the consumption of materials is less there than on the limestone rock in the neighbourhood. He does not use any faggots in such cases, nor any stones larger than six ounces in weight; and these

never sink in the bog, but unite into one mass like a piece of timber, which rests on it. He makes such a road generally at three different times: and he always prefers working in weather not very dry. The surveyors are directed to carry a pair of scales and a six ounce weight in their pockets, as a check upon the workmen.

Mr. MacAdam has generally found reason to approve the usual regulations respecting carriage wheels: but he thinks broad wheels less advantageous to roads than is commonly supposed. He suggests that the tolls might always be fairly made proportional to the exact number of horses employed; except that the wagoners should be encouraged to harness them in pairs rather than in line. The conical form of broad wheels he thinks very injurious.

ESSAYS ON BLEACHING.

By James Rennie, A. M. Lecturer on Philosophy, &c. &c. London.

No. III.—CHEMICAL AGENTS USED IN BLEACHING.

SECTION I.—As bleaching is wholly carried on by the chemical action of certain agents upon the goods to be bleached, it is obvious that the consideration of such agents ought to hold a distinguished place in an essay on the art. If bleachers, indeed, were better acquainted than they usually are with the chemical agents which they employ, their processes would be carried on with more certainty, with more rapidity, and, for the most part, with more economy. Certainly no improvement of much importance could be made by any one, unless he had previously possessed a knowledge of the chemical properties of the agents, and the materials to be operated upon. I hope the utility of the subject will form a sufficient apology if I should dwell on these agents at some length. I shall begin with one which is often omitted by those who have written on bleaching; namely, water.

1. *Of Water as an Agent in Bleaching.*

In all the processes which have ever been invented for bleaching, water is a principal and necessary agent; and it is not likely that any mode will ever be discovered in which its use may be dispensed with. Nay, the most ancient process seems to have consisted in little more than frequent waterings and evaporation; and even at this day, in some parts of India, as we are told by Des Charmes, this mode has never been laid aside, nor improved. This ingenious chemist has made some interesting experiments on water bleaching, which it may not be improper, in this place, to detail. He was led to consider the subject from two observations which he had frequently made. The first was, that rags of unbleached cloth, when set to ferment for the purpose of making blotting paper, became white to a certain point, from washing and soaking. The second was, that pieces of brown linen which are sewed upon accidental holes or rents in cloth, to prevent such from enlarging in the fulling mill, became, in two or three days, as white as if they had been several months subjected to the

usual mode of bleaching. To ascertain the extent to which he might generalize those observations, he began his experiments by macerating a quantity of flax in pure river water. in which it was allowed to remain till air bubbles arose to the surface, when it was found to have changed from gray to light yellow. The water was then changed, and the same process repeated, when it was washed in warm water. This treatment disengaged a great quantity of colouring matter, and the flax became, in a state of division, white and beautiful; but in the mass it had a slight tinge of yellow. This, farther experiments might probably have removed. The same chemist macerated in water, for a fortnight, dry hemp stalks gathered six months before. They were then rubbed under water till the fibrous part appeared. This was separated and left to steep for several days in fresh water, when it was again rubbed and again immersed. It now appeared of a very beautiful white, nearly equal to that bleached in the usual way. These experiments prove that water bleaching is practicable, and lead us to infer that Mr. Lee's process, if generally adopted, is likely to supersede every other mode.

The qualities of water it is necessary to attend to, at the most early stage of the preparation of flax, namely, when it is in the watering trough; for if this is not taken notice of, the flax may be rendered good for nothing. Next in importance to Dr. Home's introduction of sulphuric acid souring, I therefore reckon his experiments upon water—experiments which every manufacturer should be well acquainted with, and of which no chemist should be ignorant. He found that flax steeped for the usual time in hard water, was little more affected than when put in, and even when it was longer immersed, that it did not acquire that smoothness to the touch arising from the dissolved mucilage of the flax, which is the criterion of flax properly steeped. This seems to arise from the power possessed by hard water of retarding putrefaction, a quality which was known so long ago as the time of Celsus; *Aqua dura*, i. e. *ea quæ tarde putrescit.* The steeping of flax is designed to introduce the putrefactive fermentation, in order to loosen the fibrous, from the woody part; and the neutral salts in hard water, in consequence of their affinities, not only retard the process, but actually prove injurious to the fibres. The strong antiseptic qualities of moss water render *it* equally hurtful. After this plain experimental statement, it is somewhat strange that Mr. Higgens (p. 9) asserts directly the contrary; namely, that flax steeped in water rendered hard by selenite, soon becomes rotten. The sulphate of lime he admits to be the strongest antiseptic of any saline body; but although putrefaction may be retarded by a large quantity of an antiseptic, it is quickened by a small quantity, as is proved by the curing of meat with common salt. Hard waters, then, seem, according to this view of the matter, to act too powerfully on the flax, by extending the putrefaction to the fibres themselves. When soft water is used, the fermentation goes on readily; and if it do not, it should be assisted, on the same principle that bread is leavened, by the addition of some substance, in an actual state of putrid fermentation. The Dutch, to whom we were formerly so much indebted for bleach-

ing linen goods, are well aware of this, and carefully lay over the flax, when put in the pond, a quantity of mire and dirt, previously taken from the bottom. Water, then, which is hard, and much more moss water, ought to be carefully avoided in this process. The latter requires several weeks or even months to induce the proper degree of fermentation. It is the more requisite to mention this, because some may suppose moss water, from its great softness, to be the best which can be used.

Dr. Home mentions three different sorts of water. The first, neither changes with alkaline salts nor curdles soap; the second, loses its transparency on the addition of such salts, but it does not curdle soap; the third, both curdles soap and becomes lactescent with the salts. The first sort is what is called soft water, and ought always to be used; the two latter sorts, and particularly the last, ought never to be employed in bleaching. The most common extraneous additions in our waters, which are the causes of their hardness, are the sulphate of lime and the sulphate of magnesia, together with the supercarbonate of lime. When soap is used with such waters, a double decomposition takes place; the sulphuric acid of the selenite unites with the alkali of the soap, and forms sulphate of potass, or sulphate of soda, which remains in solution; while the magnesia or the lime unites with the tallow, and forms an earthy soap, an insoluble compound which swims upon the surface of the water like curds. In this way, hard waters require much more soap for any given purpose than rain water, or waters which do not contain earthy salts. In washing linen, for example, it would require as much soap to produce a proper effect, as would supply a sufficient quantity of alkali and tallow for combining with the sulphuric acid, and the lime or the magnesia nearly to the point of saturation. The loss which would thus be sustained in extensive works is obviously great, and demands the serious attention of the manufacturer. In the process also of boiling linen in alkaline leys, hard water produces great injury and waste of alkali; for the sulphuric or carbonic acid of the water combines with the alkalies, neutralizes them, and, consequently, renders the ley quite effete for the purposes of bleaching.

The saline substances, then, which render water hard, must be either decomposed or neutralized at the expense of the alkali, before the effect intended can be produced; and the bleacher may, in this manner, without being aware of it, lose whole tons of potash and soda, not to mention the extra consumption of the expensive article, soap.

In choosing a situation for a bleachfield, then, the very first circumstance to be attended to is the quality of the waters. In some cases this may be known at once from the mineral products of the vicinity. In a lime district, for example, it may be inferred with considerable certainty, that the waters will hold, in solution, either the sulphate or carbonate of lime. If water, again, runs through gravel, it is likely to be nearly pure and soft; for the gravel acts as a natural filter, and separates all extraneous matter which does not exist in it in a state of chemical combination. It may be remarked, however, that water which holds the earths mechanically suspended, that is, such as ap-

pears muddy, is somewhat less prejudicial than that which holds them in solution. In the first case, they attach themselves but loosely to the stuff; in the second, they are precipitated in a state of minute division, and combining with the acids or the alkalies used in the several processes, they become intimately united with the cloth. The inexperienced should here be cautioned not to trust too much even to waters which appear soft, without subjecting them to chemical analysis; for they may contain substances injurious in bleaching, though they do not curdle soap. This may particularly happen with regard to rivers running over calcareous strata, or through a district where lime is much used for the purposes of agriculture, in which case, the lime will be mechanically mixed with the water. Now, whenever cloth which has been washed in such water, is put into the souring vat, the lime which it will take up from the water, and which must adhere to it, will instantly combine with the sulphuric acid and form an insoluble compound, which no subsequent process yet known can entirely remove. Where no other waters can be had, fine calico bleaching for the purposes of printing can never be attained. An instance is given by Mr. Parkes, (Chem. Ess. IV. 163,) which sets this in a very strong point of view. In an extensive work for bleaching and printing calicoes in Scotland, the water of the river Don was used, but the process being always attended with uncertainty, the proprietors tried all the springs adjacent to the manufactory by chemical analysis. A spring was thus discovered which required a less expenditure of alkali in the process, and improved the look of the finished goods. This water, although distant three miles, they conveyed through pipes to the work, where it fell into a cistern containing a thousand gallons, made with granite and Roman cement, and well puddled on the outside with clay. The cost of this water work was above £2000, and yet the proprietors say that they have no cause to regret the expense. It is of importance in cases of this kind to ascertain how much water a pipe of a given calibre will deliver in a certain time; because iron pipes, when not kept nearly full, oxidize on the inside and spoil the water, and, on the other hand, when not large enough, they are liable to burst. At the work on the Don, the oxidizing of the iron is prevented by stopping the circulation of the air in the pipes by means of a stopcock. The reservoir is 50 feet long, 30 feet wide, and only 10 feet deep. It was made so shallow for the purpose of exposing a large surface of water to the air, because the water passes previously over a bed of limestone, and contains, in consequence, some lime in solution, which exposure to the sun and air precipitates by facilitating a combination of the carbonic acid of the atmosphere with the lime. To prevent this precipitate from being disturbed by the rushing in of water from the pipe, a square wooden pipe, placed perpendicular to the reservoir, receives it and carries it to the bottom, where it is quietly distributed. The uppermost stratum of water, then, must always be the purest, and this only, by means of an ingenious contrivance, is what is used. The pipe which conveys the water from the reservoir extends for a considerable length into it, and is fitted with a flexible leather joint, 13 inches long, and

also with a rose head, which always is kept near the surface by a large air ball of thin copper, capable of swimming one half above water. The leather tube is prevented from collapsing by means of copper rings. In making a reservoir for a bleaching work, it is of importance to remark that it should be lined with freestone, and not with brick, because most of the bricks of this country have the property of hardening water, which this stone has not.

The same author gives us a similar instance, strongly illustrative of the importance of attending to waters for bleaching, but in which the contaminating substance was different. In the case in question, the bleaching waters ran through a coal field in Yorkshire, and the water from the pits decomposing the pyrites contained in the coal, disengaged the iron and the sulphur, and washed them into the stream. The water of the river (the Calder) was found to answer tolerably well, after heavy rains, on account of the diluted state of the coal waters; but in summer, when the weather is best for crofting, the goods were always stained and yellow. The bursting of a worn out coal pit in the vicinity, by pouring into the river a stream loaded with the results of decomposed pyrites, rendered the water totally unfit for bleaching. The proprietors, as in the former case, procured good water from a distance at a considerable expense. In consequence of which management, their consumption of soap has been so much diminished, from the superior quality of the water, as to save them annually the sum of £50; a very great saving in an establishment which is by no means extensive. The manufacturer should be earnestly entreated to examine carefully such waters as are supposed to be contaminated with iron, because if it exist in them in any considerable proportion, it renders them very unfit for his use; and considering the universal diffusion of iron through the mineral kingdom, water can seldom be found wholly free from this mineral. In a trap country in particular, iron generally abounds, and we find accordingly, that the bleachers in the neighbourhood of Glasgow find the iron which comes from the basalt rocks very troublesome to manage. Moss waters also commonly contain a large proportion of iron solutions, especially after heavy rains.

ENGLISH PATENTS.

To NICHOLAS HEGESIPPE MANICLOR, *of Great Guilford Street, Southwark, in the County of Surrey, Chemist, for his Invention of a new Preparation of Tallow, or other Fatty Substances, and the application thereof to the purposes of affording Light.*

THIS invention is a peculiar method of operating upon tallow, for the purpose of refining or purifying it, and which, when made into candles, affords a much more beautiful light, than any other material hitherto used for that purpose.

The patentee proposes to take raw fat, say about four hundred weight, and to boil it, with about fifteen gallons of water, in a close

vessel. A valve opening outwards, is to be inserted in the top of the boiler, and loaded, so as to resist an internal force of about fourteen pounds upon every square inch, that is a pressure of one atmosphere. The tallow having been boiled in this vessel for the space of about six hours, is then to be poured off and cooled to about 90 Farh. when it is to be spread out in layers, not exceeding half an inch in thickness, upon woollen cloths of close texture, or upon felts, all of the same size.

On the tallow becoming hard each layer is to be folded up, by turning over the corners of its cloth or felt. These parcels are then to be piled one upon another, and pressed by a weight equal to about half a ton, placed upon the top of the pile. At the expiration of about one hour, an additional weight is to be applied, making the pressure now about one ton; and in two hours time, this weight is to be augmented to a ton and a half, in which state it is to remain for at least four hours, in a temperature of about 80°.

The packets may now be removed, and the edges of the tallow pared round, in order to take off those parts which have been imperfectly pressed; the cuttings from the edges are then to be placed on the middles of the cakes, and the whole packed up in the cloths or felts as before, and piled upon each other under an hydraulic press, which is to be progressively increased in force, so as to express all the remaining oily matter gradually out of the tallow.

The cakes are now to be removed from their envelope, and having become extremely brittle by the pressure, are to be broken up and re-melted in a vessel heated by steam, and to be incorporated with bees' wax or prepared linseed oil; the proportional quantities of these materials are to be about one hundred weight of fat to twenty pounds of wax, which must be of the purest fine white quality; if linseed oil be preferred it must have been previously concentrated by boiling, and brought to the consistency of turpentine, and then mixed in the proportion of ten pounds of the prepared oil to one hundred weight of the fat, but these proportions will depend upon the quality of the fat and of the oil.

The proposed method of preparing the oil, is by heating it in an open vessel until it gives out an inflammable vapour. The gas evolved is then to be burnt as it rises, until the quantity of the oil becomes reduced to two thirds of its original volume; it is then to be exposed to the action of the air for one month previously to using, and may be employed as above instead of bees' wax.

These materials having been melted together by the heat of steam, as above directed, are then to be submitted for three or four days to the action of chlorine gas, for the purpose of bleaching, and to be frequently stirred up during the operation; this is to be performed in a close vessel having glass windows for the admission of light into the interior.

The tallow thus prepared is now to be boiled, in pure water, for the purpose of removing all odour that it might have retained, and a quantity of newly prepared animal charcoal introduced, in the proportion of about one tenth the weight of the fatty matter. These are to be

boiled together for the space of six hours, and afterwards filtered through woolen cloths, at a temperature of about 150°, when the process of preparation may be considered to be complete, and the material fit to be moulded into candles, which should be done at the lowest temperature that the fat will flow.

The patentee proposes under some circumstances, instead of preparing the fat by boiling it in water, in the manner above described, to melt it in the ordinary way employed at present, by tallow melters, and then to mix one part of oil of turpentine with seven of tallow, after which the cakes are to be submitted to pressure as above directed.

The turpentine expressed by this last mode of operating, may be recovered from the oily matters by distillation, and the residue of oil will be suitable for any of the ordinary purposes, of burning in lamps, making soap, or any other use to which animal oil has been commonly appropriated.—Enrolled, September, 1826.

[*London Journal of Arts and Sciences.*

To JOHN MASTERMAN, *of Old Broad Street, in the City of London, Gentleman, for having Invented or found out an Improved method of Corking Bottles.*

THE patentee proposes to press corks into the mouths of bottles by the force of a lever, instead of hammering them in by means of a mallet, as commonly practised to the great risk of breaking the glass. A machine for this purpose may be variously constructed, therefore no particular form is prescribed. It should, however, consist of a bottom fixed rail, and upright standards, in the latter of which, the fulcrum of a lever is to be placed. Another rail is to be affixed to the standards, about one foot above the lower rail, and through this a conical hole is to be made to receive a conical funnel, into which, the cork is to be introduced.

A flat board is laid upon the bottom rail, for the bottle to stand upon, and this is afterwards raised by means of a wedge, until the mouth of the bottle meets the under side of the funnel above mentioned. A cork is then to be dropped into the funnel, which being widest at top, allows it to enter freely. The end of a plunger or rod, fitting the inside of the funnel, is then placed upon the top of the cork, and the rod being pressed down by the lever before mentioned, the cork becomes compressed in its diameter, as it passes through the smaller part of the funnel, and is then forced into the mouth of the bottle, where expanding again by its natural elasticity, the liquid in the bottle is more perfectly secured air-tight, than by the ordinary mode of biting, or otherwise pressing the end of the cork, previously to introducing it into the bottle by hand.

The patentee considers, that an apparatus consisting of such parts, as will effect the object above described, may be made in a variety of shapes, he therefore confines himself to no particular shape or construction, but claims particularly the conical funnel for compressing

the cork, and passing it into the bottle, and states, that any apparatus having such conical funnel applied for the above purpose, he shall consider to be an infringement of his patent right.—Enrolled, July, 1825. [*Ib.*

To Enoch William Rudder, *of Edgbaston, near Birmingham, in the County of Warwick, Cock-founder, for his Invention of certain Improvements on Cocks for Drawing off Liquids.*

The patentee having observed, that very considerable inconvenience frequently arises from the plug of a liquor cock fitting too tightly into its socket, and that to prevent leakage, such fitting must be very accurately made, proposes as an improvement in the construction of cocks generally, to place a tube of cork round the plug, and to cause the elasticity of the cork to produce the air and water tight fitting, instead of bringing the accurately ground surfaces of the metal plug, and its metal socket together, as is usually done.

There may be several modes devised of coating the plugs of the cocks with cork; one mode suggested by the patentee, is to cut the cork to its cylindrical figure, fitting the socket, and then to bore the aperture for the plug, by means of a sharp cylindrical tool; or the cork may be formed in a lathe, by turning against a sharp tool. It is proposed when these coatings of cork are properly fitted, that they should be immersed in water and boiled in their sockets, having a plug within to keep the cork to its figure; by which means, they will be made to fit more perfectly.

This contrivance may be applied to cocks of almost every form and kind, and therefore the patentee does not confine himself to any particular shape, but claims the invention of coating the plugs or lining the sockets of cocks, with cork, as perfectly new.—Enrolled, July, 1825. [*Ib.*

Specification of the Patent granted to Lewis Aubrey, *of Two Waters, in the county of Herts, Engineer, for an improvement or improvements in the web or wire for making paper.* Dated July 4, 1826.

I, the said Lewis Aubrey, do hereby declare, that the object of my invention of an improvement, or improvements, in the web or wire for making paper, is to produce the large water mark on wove paper made on a machine working with endless wires or moulds, and which I accomplish by my said improvement or improvements in the web or wire, as follows. The warp is to be put on the loom in the usual way, consisting of small wires, according to the number of holes to the inch, as may be required, without the large warp being applied, until the small spaces in the reed are filled, agreeably to the width wanted; and when properly fixed at both ends, then a wooden or metal roller, about five inches diameter, and as long as the loom is

wide, is to be fixed, resting on two iron bearings, at the tail end of the loom, at a little distance below the bottom roller, not quite under the centre. This roller must have a groove in it, so as to take a wooden or metal strip, into which roller the same is to be fixed by screws; and the said strip must also contain as many pegs of iron, steel, or other metal, as large water marks may be required in the sheet of paper, standing about a quarter of an inch out of the roller, above the surface, and divided to answer the large divisions left in the reed, from a quarter of an inch to one inch and upwards, at equal or unequal distances, as may be desired. The large warp is then to be placed on to each of the pegs, either circular or otherwise, round the five inch roller, until there be a sufficient length; then each large warp (either circular or otherwise) is to be passed through the front harness, which should be very strong, and placed a little higher in the work than the small harness; from thence they are to be passed through large divisions of the reed one by one successively. Large divisions are left in the reed, for the purpose of receiving the large warp, and the ends made fast to a round iron rod, half an inch in diameter. I then place a metal roller to lay loose on the large warps, on a level with the bottom of the five inch roller; by which means, the whole of the large warps are made tight, equally with all the small warps. The weaving is then to be done in the usual way by throwing, to suit the number of holes required; and by means of a strong harness, standing higher than the small ones before described, the large warp is rendered flush with one surface of the wire, and projecting on the other surface.

The size of the wire required, is governed by the number of hole work, as No. 8 warp intermixed with No. 15 or 16, when put to work, will show the large longitudinal water-mark lines, commonly seen in laid paper. A warp may also be produced, consisting of wires the same size, with a weft of similar wires, with large ones inserted transversely at equal or unequal distances, whether circular or otherwise, so as to produce transversedly the large water-mark lines common in laid paper.

The wires may be made to any length and width used on machines, or moulds, and of any metal used in wire weaving.

[*Repertory of Patent Inventions.*

Specification of the Patent granted to Edward Heard, *of St. Leonard, Shoreditch, in the county of Middlesex, Chemist, for a composition or compositions to be used for the purpose of washing in Sea and other water.* Dated May 8, 1826.

I, the said Edward Heard, do hereby declare that my composition for rendering sea-water fit for washing, is thus performed. To a very concentrated solution of either of the alkalies, called soda and potash, I add an equal weight of any earthy base; but I give a

preference to, and usually employ, a native earth or earths called China clay, or porcelain earth. The alkaline solution and this earth being first well combined together, the mixture is then ground in a mill similar to what is used for grinding white lead in oil. This produces a homogeneous thick paste, one pound of which is sufficient to soften four gallons of sea-water.

Secondly. My composition for washing in fresh water, consists in chemically uniting either of the above-named alkalies of soda or potash, with any resinous base; but for cheapness and suitability, I prefer for this purpose common rosin.

Any given weight of this substance may be boiled with the alkaline solution in a caustic state, until it is brought to a very thick pasty consistence, entirely soluble in water, when it is in a fit state for use, and may be employed as soft soap usually is, for the ordinary purposes of washing and scouring.

Remarks by the Patentee.

It has long been considered a desideratum to render *sea-water* available for the purposes of *washing*. Several attempts have consequently been made at various times to effect this object, but they have uniformly *failed* from errors in *principle*.

Instead of originating an inquiry into the *causes* which *prevent* soap from *washing* in *sea-water*, these attempts have invariably been directed to the fabrication of *soaps*, which should at *once* answer the purpose, without any preliminary *treatment* of the *water*.

The futility of these efforts clearly betray the absence of all chemical science in the pursuit.

My researches, which began above twelve years ago, were, however, differently conducted.

They commenced with an *analysis* of the *constituents* of *sea-water*, the *nature* and *quantity* of its *saline parts* were accurately determined, and this *first* step, naturally developed the *means* best adapted, for rendering sea-water fit for washing.

The presence of the earthy salts called muriates of lime and magnesia were found to offer the *chief* obstacles:—they necessarily decompose *soap* from the superior affinity of their *acids* for the *alkali* of the latter.

Thus then, as a quantity of soap must in the first instance be destroyed to afford a sufficient supply of alkali to neutralize these acids (liberating at the same time the fatty base of the soap which attaches to the linen, and thereby increases the difficulty of washing,) it became obvious, that the proper mode of proceeding was to decompose these earthy salts, *preparatory* to the *use* of soap.

An alkaline solution of a certain specific gravity was then prepared, and added to a known quantity of sea-water, until saturation took place. The *quantity* of this re-agent sufficient for a *gallon*, was thus correctly ascertained; and on every trial, it always produced similar results.

On its introduction into the service of the royal navy, it was hailed as a most useful discovery, conferring an important benefit on the

seaman, and affording great facility to the maintainance of cleanliness on ship-board, so *essential* to health! but unfortunately the *state* or *form* in which this re-agent was *then* prepared and confided to the care of seamen (who are ever fearless of danger, and too often neglect the precautions given to avert it) occasioned some accidents, which ultimately led to its disuse.

The alkaline solution in a caustic and very concentrated state was liable to be spilled, and falling on wounds or cuts, would, of course, create pain and excoriation; some few occurrences of this nature soon operated to lessen its utility in the estimation of one of the Government Boards, and its further supply was ordered to be discontinued.

Though deeply disappointed, my efforts were nevertheless unremitted, to free the application from every objection. During the course of very harassing investigations, I learnt that one of the usual processes in washing on board of ship, consists in the use of *urine* and *pipe clay*, which latter they scrub with a brush on the surface of the linen, and finally rinse in the surrounding sea-water.

To supersede a practice so odious, so filthy, and altogether so inadequate to the purpose, I conceived the idea of employing an *earthy* base more *saponaceous* than *pipe* clay, which, while it should act as a detergent, might at the same time become a useful vehicle for the absorption of the alkaline solution, and form therewith a paste in a tangible state, safe to handle, easy of measurement, and readily diffusible in sea-water.

The process described in the specification above, prepares the composition on this principle, and completely answers the intended purpose.

On the admixture of this paste, with its due proportion of sea-water, a thick cloudiness is perceptible, arising partly from the earthy base of the composition, and partly from the liberation of the earths of lime and magnesia, constituents of the muriates. These, in a state of mixture, are suffered to subside, and the clear water afterwards separated either by a syphon, decantation, or filtration, as happens to be most convenient. The earthy deposit may then be more efficaciously employed than *pipe-clay*, in all cases where the latter had *formerly* been used; and the clear sea-water may be advantageously applied for the removal of these earths, should any adhere to the clothes, and for finishing the wash with *soap*, in the way usually practised by laundresses. Should facilities exist for the purpose, the sea-water would answer best if previously heated, the precipitation of the earths would be accelerated, and the operations more effectual and expeditious; but under every possible disadvantage, *cold* sea-water may still be successfully used.

Passengers and others proceeding on long voyages, whose garments are usually of a finer quality than those of common sailors, should only use the *clear* sea-water, and reject the sediment as inapplicable to *their* wants; this will enable them to perform a wash with as much neatness and effect as is done on land; and they may rest assured, that the apprehensions hitherto entertained of catching cold from the dampness of linen washed in *sea*-water, are quite groundless in this

instance; for the earthy salts, so attractive of moisture in their *natural* state, being decomposed and separated, can no longer produce such effects, and the salts which actually do remain in solution, possess no such *deliquescent* property.

The *second* object of the patent is a composition for washing in *fresh*-water.

The resin here employed as its base, has, it is true, been used before, though in a very limited proportion (perhaps from an eighth to a sixteenth part) in *combination* with *fats* and *oils* to compose a soap, known in commerce as *yellow* soap; but it has always been *confined* to *this description* of soap, and never before formed into a *binary* compound, to the entire exclusion of all fats or oils in the composition. *Soap*, in fact, may be defined to be a ternary compound, consisting of *fat* or *oil*, an *alkali*, and *water;* any substance added to these, is only extraneous, and put in either with a view of adulteration, or to give a particular character or quality to the soap; the above resinous compound, therefore, cannot possibly come under the designation of *soap*, differing so essentially as it does in its *constitution* and appearance; it nevertheless possesses properties in common with soap, such as perfect solubility in water, and even a greater degree of *detergency*.

This *latter quality* and its *low price* must particularly recommend it to the consideration of those whose consumption of soap is extensive; and in all cases where *economy* becomes an *object*. [*ib.*

On cheap and easy methods of preventing Houses from taking fire, and on the necessity of establishing regulations to enjoin the adoption of some means of this nature in the Metropolis. By MR. J. W. BOSWELL.

[FROM THE REPERTORY OF PATENT INVENTIONS.]

FEW situations can be conceived more horrible than that of a family in the upper part of a house on fire, having the staircase in flames, waiting for the tardy assistance of ladders, and expecting every instant to fall a prey to the devouring element. Yet how often families have been exposed to similar sufferings of late in this city, and to what is much worse, the dreadful reality of some of their nearest and dearest connexions having actually thus perished in tortures too shocking for contemplation, we have only to run over the public registers of intelligence for the last year to convince ourselves.

In my small circle of acquaintance, I know a gentleman who lost his only son in this manner, who was a very amiable, clever, sensible young man; and a lady, whose uncle and his whole family, (consisting of his wife, near her lying in, two daughters, one thirteen years of age, the other seven, and a son nine years old,) suffered a similar fate, with some aggravating circumstances; for the father, finding he could not save his family, rushed into the flames to perish along with them: and probably there are now many persons here, who could produce examples as sad as these I have mentioned; and some who could authenticate facts still more distressing.

Yet, sensible as we all are of the shocking nature of these circumstances, we soon forget them, and do not carry home to ourselves the appalling truth, of our being all continually liable to a similar fate; we look on this with a torpor truly astonishing; and while we interest ourselves, and make large subscriptions to avert the sufferings of people removed half the globe from us, view with indifference dangers of such magnitude to every thing we hold valuable, and take not a single step to prevent them, no more than if they were the result of inevitable fatality; which is so far from being the case, that it is from the want of attention alone of those, who have the power to regulate the construction of our buildings, that so much risk, and so many sufferings arise.

We pity the infatuation of those who reside on the sides of volcanoes, exposed to the overflowings of lava, the overwhelming of ashes, and discharges of stones, by which whole cities have heretofore perished; and yet are quite at our ease in situations nearly as bad. Every one knows what a large portion of London was formerly destroyed by a single fire, and the devastations before-mentioned of that element last year in various parts of the metropolis (some of which were to a very large extent) are still fresh in the memory of all. In other countries the same has happened in a remarkable manner. The city of Lyons in France was at a remote period totally destroyed by an accidental conflagration, and a remarkable expression of Seneca relative to this event is often quoted, which imports that between a city in a flourishing state and one totally desolated, the space of a single night alone intervened. But while the conflagrations of London have produced no change of consequence in the construction of the houses to lessen the risk from fire, what Lyons has suffered in this respect seems to have had a direct contrary effect; for at present the houses in it in general are built admirably secure against this tremendous danger; it is true that, in Paris, and many other cities and towns in France, somewhat of the same care is to be observed, but there it is eminently conspicuous from their stair-cases as well as their floors being fire-proof.

It might be thought that to secure houses in this manner, would be extremely difficult, and attended with enormous expense, from its not being attempted in this country; but this is by no means the case; on the contrary, the means are simple and easily executed, and the expense, taking every thing into account, sometimes less than in our mode of building: a few lines will serve to prove this. Throughout France, as far as I have heard, the method which they use in the two cities mentioned, in laying the floors of their houses, is followed; there, after fixing in the beams and rafters, they first nail on over the latter, coarse rough boards, and then cover the whole, some inches thick, with plaster, over which again they lay tiles, mostly of a hexagonal form, and about six inches across, and often smaller. Square tiles are only used for kitchens and passages, and sometimes thin slabs of stone are laid in the better apartments; and even where the *parquet* floors are used, the plaster is never omitted, so that even if one of the thin walnut pannels of the parquet should be burned by

accident, the fire cannot penetrate to the joists, or spread laterally from want of air from below. I believe the coat of plaster in the floor is never less than five or six inches thick. I have seen it of nine inches in thickness in the upper floor of a building in the Fauxbourg du St. Marcel, in Paris, which was formerly a convent of Carmelites, and is now a manufactory, where I had an opportunity to measure it, in an aperture newly made through an upper floór, for the passage of the revolving leather bands of some machinery.

It may be easily conceived what security floors formed in this manner give against fire; and in fact, it is so great, that, on all those covered with tiles, or with stone slabs, fires might be made in the middle of the rooms without any danger; which indeed, is often put to the proof, for that is the place where the lower classes generally fix the iron stoves, or those made of tiles, which have come so much into use there of late years; and as some of this class occupy the upper parts of houses, where the first nobility reside, this and the very careless habits of the French in general, respecting fire, would often produce fatal accidents, that could not be buried in obscurity, if not counteracted by the effect mentioned, of the thick plaster coating under the tiled surface of their floors.

In Paris, several of the staircases of the better houses are of stone, and in the other houses they are made of a frame-work of wood, intermixed with bricks and plaster, and covered with tiles; which affords a good defence against fire, though inferior to the stone, as is frequently tried by the *Portieres*, whose favourite place for establishing their *marmites* to make their soup, is close to the staircases below, or on the landing places. But in Lyons, stone stairs are almost universal, and the security from fire, of this important means of communication, made proportionally greater; here much ingenuity is often displayed in their structure, and particularly in the smaller houses lately built, united to great simplicity of design, and the most efficient stability. The walls also of the houses, both in Paris and Lyons, are in general built with much more strength and solidity than ours. So that after experiencing for some time the great security against fire which houses built in this manner afford, on returning home to our deal floors, wooden staircases, and partitions of wainscot, or of lath and plaster, our houses seem like so many funeral piles of the ancients, only waiting for the application of the torch, or the casual fall of a candle, to burst into flames, and consume the inhabitants.

In attributing the security of the French houses from fire to the thick coat of plaster, which forms the basis of their floors, my observations are confirmed by the experiments of Lord Charles Mahon on this subject, as published in the Philosophical Transactions for 1778, p. 884. He preserved buildings from taking fire from fuel purposely kindled to prove them, by surrounding the joists of the floor with plaster, or filling up with it the intervals between them, having first had slips nailed along the sides of the joists, and short laths laid across over the slips to support the bed of plaster. I have seen in some of the houses newly erected in Paris and in Lyons, circumstances, which led me to suppose, that the plaster of their floors was sometimes sup-

ported in a manner somewhat similar; for in several of them I have observed battons nearly an inch in thickness, nailed beneath the joists of the floors with nails full as long as our twelve-penny nails, instead of the common ceiling laths, before any boards whatsoever were laid over the joists; which I concluded could be for no other purpose but to support beds of plaster between the joists, so as to dispense with boards entirely, which the nature of their plaster would very well enable them to do; for being made from gypsum, which is the common material of the country, it swells so much in setting as to occasion a strong lateral adhesion to the sides of the joists, which, in addition to the support of the battons, and of the coat of plaster above the joists, might very well support the flooring tiles, and any common weight likely to be laid on them; besides which, their dry plaster in a mass, as they prepare it, is nearly as firm and solid as our Bath stone, and will sustain very heavy weights before it will break.

Custom and fashion are with us like the imaginary gods of the heathens; and although we do not build temples to them, yet we cease not to sacrifice human victims to their power. To point out the folly of continuing to make burnt-offerings to custom, by persevering in building houses so liable to combustion, and to request some attention to, and calculation of, the numbers who have perished in flames through this usage, might be thought sufficient to obtain some relaxation in its continuance, or at least render matters so trivial in comparison as the colour of a floor, of no moment whatsoever: but too much experienced in the power of this false divinity, not to know what weight this small matter would, from its influence, be made to obtain, I am happy in being able to point out a means of obviating objections on this point; and in so far helping to render more secure the lives even of those, who would sooner risk them than use red tiled floors in their chambers (though tiles shaped as in France, painted, and kept bright by wax, are far from having a disagreeable appearance;) and who, though it is obvious that they could be easily covered by carpets, would continue to reject them.

Chance threw in my way in Paris a spacious handsome saloon, which for a considerable time I thought was floored with *parquet*, (or squares of pannelled, or inlaid work, composed of short narrow pieces of walnut-wood;) the addition of a large carpet, which is very unusual there, helped to keep up the mistake; but a bolt having to be put into the floor at the bottom of one of the double doors, the workmen in fixing it, made a cavity in the floor, which showed at once that it consisted solely of plaster, or gypsum, painted over, but so well painted, as to deceive on a casual inspection.

The application which might be made of this circumstance here, struck me forcibly at the time, and appears so obvious, that I think I may now fairly demand of the most rigid votary of custom or fashion, without much risk of an effectual reply, if they had the floors of their chambers prepared with gypsum plaster in this manner, and painted so as to imitate the grain, colour, and interstices of deal boards, not even forgetting heads of nails, (which the talents exhibited on numerous hall doors, prove that we have many artists capable of executing,) and

if all were well covered with the usual allowance of carpeting, whether the risk of being convicted of deviating from the actual deal boards, by some friend with a microscope, would not be amply compensated by the safety to their families and property, which such floors thus prepared would occasion?

This last method of preparing floors, in addition to the advantages mentioned, would also most probably cost less than deal floors, particularly if the builder prepared his own gypsum from the rough blocks landed on the wharves, as he ought to do in this case; and, in some parts of this country, this is so well known, that plaster floors have been used there as a matter of economy, longer than I can at present state; but I can well recollect that I saw plaster floors in upper rooms near Uttoxeter, many years ago, and understood then that it was a practice of ancient date; the plaster is of a gray colour there, and only used for bed rooms; but even this sort, if painted as I have mentioned, might serve for the best rooms in the house; at any rate gypsum, which forms a perfectly white plaster, is to be had in abundance in various parts of Great Britain, and in the North of Ireland, so that the use of the other sort is not a matter of importance, but only as a local convenience. The substance of which the gray plaster floors were made, was found in the neighbourhood, and was said to be of the nature of gypsum; but from its colour, I rather suspect it to have been what coal viewers call *clunch*, which consists principally of clay, bituminous matter, silex, and iron; and which, when prepared by calcination and pulverization, is asserted by good authority, to afford a water proof cement, equal, if not superior, to Roman cement.

It should also be noted, that if tiles should be preferred for floors, it is not indispensable that they should be red; white tiles could easily be procured from the potteries, or thin slabs of Portland stone might be used for the same purpose, where a little additional cost was not an object; and for houses of men of large property, we have ample means of producing the most beautiful floors conceivable, by reviving the tasselated floors of the ancients, which only require a demand, to be produced in equal beauty with their best specimens, the method of making them being perfectly well known, and, in some respects, still practised in Italy.

Floors of the description mentioned might be objected to for their being cold to the feet in winter, but on this point I can speak from experience, having used in France floors of tiles, of stone slabs, of painted gypsum plaster, and of walnut parquet, and can answer for it, that through a good carpet the cold of the three first was in no degree more perceptible than that of the last, which being of wood, could be little if at all different from our deal floors in this respect, while they all had the advantage of being impervious to air, which sometimes passes very disagreeably through the chinks of our floors; and also that of intercepting all noises from the other apartments, which they separate from that occupied.

[TO BE CONTINUED.]

Messrs. Derosne *on the use of Alcohol for purifying and refining Sugar.*

The process usually employed for refining rough sugars, requires the use of a considerable quantity of lime water, and bullocks' blood. The refiners have been uncertain of the proper proportions to be used, being generally unacquainted with the action of the first, and with the ill effects resulting from too great an addition of the second. The chemical effect of the compound is unknown to refiners generally. In the process all is uncertain; the heat necessary to be employed alters the quality of the material, and the boiling of the sirop increases the inconvenience, which becomes more perceptible in proportion as the substance is drained off, for it not uncommonly happens that a gas is disengaged during the process, which is inflammable upon the approach of a light.

In the process we have adopted, the raw sugar is purified without the use of heat or of any destructive agent, such as lime water, or bullocks' blood; of which the principles on which they act are complicated, various and uncertain in their application. We substitute for the means commonly employed, the use of one agent alone, the action of which is well ascertained; this agent is alcohol, a spirit obtained by distillation of wine or grain, or whatever is susceptible of spirituous fermentation; the alcohol obtained from any of these being exactly the same in its chemical properties: we employ this agent in the following manner:

Upon a given quantity of the raw sugar we pour a certain quantity of well rectified alcohol at from 32° to 34° of the areometer of Baumé,* we shake the two substances, and then leave them for some hours to digest, repeating the agitation from time to time, after which, the alcohol is slowly poured off from the sugar which is not dissolved; this manipulation is repeated till the last portions of the alcohol are not sensibly coloured. This process is founded on the principle, that alcohol possesses the property of dissolving when cold, only the molasses, which the raw sugar contains, and not acting upon the crystallized sugar, thus separating completely all the parts of the raw sugar which are not capable of being crystallized; these parts are composed of a substance lighter than the sugar, and soluble in water, and in alcohol; they contain a feculent substance, as well as the molasses, this is probably what has required the use of the lime water, and bullocks' blood, to effect its complete separation; it is, however, by the alcohol easily held in separation from the sugar, which precipitates itself to the bottom of the vessel, under the appearance of a white sand. The sugar being well drained and dried by a very gentle heat, or in the open air, has the appearance and the taste of the fine Martinique and Havanna sugars, and possesses a degree of dryness seldom to be met with in these, with very little colour; when it is wished to make it remarkably fine, it is dissolved (after being drained, but not entirely dry,) in the requisite quantity of water heated in a covered vessel, in order to draw from it by distillation the small portion of alco-

* Specific gravity .847 to .856.

hol which it retains. This new process is much more expeditious than the old, as in less than twenty-four hours, we obtain a result, which used to require a much greater time; we employ no combustible, and greatly diminish the labour required. The alcohol employed for this purpose is not lost; that portion of it which is the most highly coloured, is immediately distilled, and gives for residue a molasses or sugared substance, not crystallizable, to be preferred for flavour, purity and clearness, to that which comes from the refiners. The other portions of the alcohol are made use of for the first washings of the new raw sugar till it becomes saturated with molasses. By the use of the alcohol the finest kind of lump sugar may be obtained in less than a month, and in much less time a powdered sugar of superior whiteness. The quantity of alcohol to be employed varies with circumstances, but generally approaches to the weight of the sugar.

[*London Journal of Arts, &c.*

A new Lithographic Wash, by M. Engellman.

It is still to be regretted that the means of giving effect to the delicate parts of designs, executed in Lithography, such as the clouds, the reflection of light, and the distances of landscape, remain to be discovered; we are therefore compelled to confine ourselves to the most simple touches, or incur the risk of rendering the parts too heavy or too black, in the absence of half-tints, so essential to the harmony of the design. M. Engellman has rendered the most essential service to the art by his lithographic wash, of which he has already made the most happy application, in the fine collection of monuments of ancient France, by M. M. Taylor, de Cailleux, and Charles Nodier, combining the advantages of a rapid and easy expedition, with that of affording to the artist a distinct view of the effect of the tints as they are produced. We give the details of the process as it is described in the eleventh volume of the Brevets of Invention.

Composition of the Ink.

Put into a metal vessel, four parts of virgin wax, two parts of tallow, two parts of dry soap, melt the mixture, stirring it frequently, till it becomes of an inflammable temperature, then throw in three parts of gum lac, and one part of water, saturated with salt, when the scum has ceased to appear on the surface, mix in one part of lampblack, the lightest possible, of the quality made at Paris, adding afterwards four parts of common printer's ink, let the mass cool, then for the facility of use, make it into sticks of about an inch and a half in thickness.

Composition of the Reserve.

To three parts of water, in which gum arabic has been dissolved in sufficient quantity to give it something of the consistence of oil, add one part of ox gall, and as much vermilion as to give a deep colour to

the mixture, so as to distinguish easily the work upon the stone. Every other colour produces the same effect, but the vermilion appears preferable on account of the brightness which makes it come out of the black, which sometimes covers it too strongly.

Design upon Stone.

To prepare the stone for the lithographic wash, it is necessary to give to it the finest grain possible, and the most equal surface, rub the wrong side of the paper with blood stone, following the strokes with a blunted point, this operation finished, cover the margin of the stone, and generally all the parts which should remain white, with the reserve before described; this colour ought to be sufficiently fluid to admit of the finest lines being made with the pencil, then pour some drops of the essence of turpentine upon the stone, rubbing the surface with a stick of the ink, the composition of which has been described, continuing this till the liquid ink which has been formed by this operation, becomes of a consistence fit for use, which can only be ascertained by experiment, then charge a ball such as is used by printers, covered with white leather, it is convenient to have several of these of different dimensions for covering the various spaces. There should be very little colour upon the ball, as only the jutting out parts of the stone should receive the colour, the experiment should be first made upon a stone that has no design, when it produces the tone required, then beat as equally as possible the whole of the surface till it has acquired the lightest tint of which it is susceptible, then cover again with the reserve, the places judged to be sufficiently coloured, and in diluting the ink, which may have dried during the operation, repeat the beating and thus produce a stronger tint, after which, cover and beat alternately, till the most vigorous tone is produced, then soak the whole of the stone in water, and rub it with a sponge.

The reserve having formed an impenetrable bed for the colour, and prevented the places which had been covered from being too deeply charged with the black, it then dissolves, carrying off all the surplus of colour, which the ball had deposited, all the tones will then appear corresponding with the design which has been traced with the reserve. Squeeze the sponge repeatedly and wash the stone, so that there may not remain the least vestige of the gum. If some parts of the design are considered to be not sufficiently coloured, the colouring and beating should be repeated till this object is effected; these operations finished, it may sometimes be necessary to retouch the design with a crayon, or with lithographic ink, or to take away parts with the scraper, the stone is then prepared by passing over it, an acid spread with water in the same manner as an ordinary design with a crayon, the printing is performed with the presses commonly used in lithographic work-shops. [*Ib.*

On Improvements in Blowing Machines, and Cupola Furnaces, for Iron-Founders. By Thomas Gill, Esq.

We have been lately favoured by an intelligent friend, an iron-founder and engineer in the country, with the following particulars of his blowing-machine. Instead of the common bellows, he employs two square trunks, made of hard and well seasoned mahogany, and well rubbed over with black-lead. These trunks are each sixteen inches square, and have wooden pistons in them, which have slips of wood on each side, around them, made to spring out of grooves lightly packed with cotton, so as to fit the interior of the trunks more accurately. These pistons are alternately actuated by means of opposite cranks, driven by the power of a horse, so as to make forty double strokes per minute; and the trunks deliver the air which they have received, through valves at their lower ends, opening inwardly, through two bent pipes fitted up with other valves, likewise opening inwardly, into a middle equalizing chest, or reservoir, which is framed between the two trunks, and is of the same dimensions with them. Upon the upper end of the chest, a circular expanding bag or receptacle formed of leather, and of a conical shape, or widening upwards, is mounted, having a flat wooden top to it, and wooden hoops at regular distances apart, similar to the upper parts of the well known cylindrical leather bellows; to the wooden top a round iron rod or stem is affixed, hanging downwards, and passing through holes made in two wooden bars, affixed across the upper and lower parts of the chest, to guide and steady the motion of the leather receptacle, upwards and downwards. The top is loaded with about two hundred weight; and a stout helical spring is affixed to the lower end of the rod, which, in rising, presses against the lower bar, and in case of the horse starting suddenly, breaks the shock, and prevents mischief. A nozzle, *two* inches in diameter affixed below, in front of the receptacle, delivers the blast into the cupola furnaces. He thus produces *a continual and nearly equable blast*, of great efficacy in fusing his cast-iron, and infinitely superior to *the sharp blast* too frequently employed to the injury of the iron which it *oxidates*, and thus frequently reduces the best pig-iron to an equality with the inferior and lower priced kinds. Besides this serious evil, a too sharp blast cools the coke to blackness instead of exciting it, as a well regulated one does.

Besides the usual cupola furnaces, this intelligent engineer has adopted one of a much smaller size, and which is also mounted upon wheels, so as to be run from the bellows near to the moulds. It is six inches and a half only in its internal diameter, and he finds it exceedingly convenient in quickly fusing small quantities of cast-iron, so little, even, as half a hundred weight at a time, when work is wanted in a hurry; he even thinks, that it might be advantageously substituted for the melting pots and wind furnaces, ordinarily employed in the small cast iron founding business, and with a great saving in the expense of fuel and melting pots. We have also been informed by an eminent iron-founder and engineer in town, that he has himself just had a cupola furnace lined, of the diameter of seven inches only inside

at the basin; although it widens above in a conical form, for the sake of holding more coke, it is not, however, mounted upon wheels.

In point of contrast with these small cupola-furnaces, the last mentioned engineer informs us, that he has lately heard from Glasgow, of *cupola furnaces twelve feet high* being introduced there, and which will contain at once, three separate charges of fuel and cast-iron; namely, one charge of iron melted, and ready to run out; another, in a great state of forwardness above it; and the third only beginning to be heated. And that, as these charges are continually renewed, not only a very great saving of time and fuel is thereby occasioned, but the quality of the iron is also greatly improved. There are two pairs of bellows employed to heat these furnaces; but, instead of delivering the blast into one aperture only, as usual, they are placed so as to deliver it into two, made at right angles to each other, in the octangular bases of the furnaces, so that the blast alternately crosses the insides of the furnaces in opposite directions.

It is not a little singular, that both in town and country the iron-founders can find nothing better to line the interior of their cupola-furnaces with, than *road-dust*. Possibly the mixture of *vegetable matters* with the sand, gravel, clay, &c., which form the ordinary materials of roads, becoming *carbonized* by the heat, may tend to hinder the fusion of the lining, as the mixture of *coke*, grossly powdered with Stourbridge clay, does the melting pots employed in cast-iron founding in the small way; (see vol. ii. p. 159. of this Journal.)

We have been informed, that at another iron-foundry in the country, which casts three tons a day on an average, the proprietors make it a practice to take down the lining of fire-bricks in their cupola-furnaces every week, and for that purpose build them up with *sand* only.

[*Technical Repository.*

FOR THE FRANKLIN JOURNAL.

MECHANICAL JURISPUDENCE.—No. XIV.

BY PETER A. BROWNE, Esq.

On the law of Patents for new and useful Inventions.

ON THE PAYMENT OF THE FEES.

On applying for a patent, under the laws of the United States, the first thing required is the payment of the expenses. The eleventh section of the act of Congress of 1793, declares, "that every inventor, *before* he presents his petition to the Secretary of State, signifying his desire of obtaining a patent, shall pay into the Treasury $30, for which he shall take duplicate receipts; one of which receipts he shall deliver to the Secretary of State, when he presents his petition: and the money thus paid shall be in full for the sundry services, to be performed in the office of the Secretary of State, consequent on such petition, and shall pass to the account of clerk hire in that office."

Every one the least conversant with the subject of taking out pa-

tents in foreign countries, will be struck with the smallness of the sum required by the Act of Congress.

It will be observed, that the payment of the $30 is a prerequisite to the presentation of the petition. Nevertheless, if the officer issues the letters without the money being paid, the patent will not be thereby invalidated.

THE METHOD OF APPLYING FOR A PATENT.

The method of applying for a patent is by a PETITION. In England, the petition is directed to the King. In the United States, it is addressed to the Secretary of State, signifying a desire of obtaining an exclusive property in the invention, or discovery; and praying that a patent may be granted therefor.

In Godson's law of patents, page 47, it is stated that there is no clause in the English Statute by which the subject can *demand* a patent as a matter of *right;* that it is a free gift of the King, emanating from him as the patron of Arts and Sciences, and granted as a *gracious favour*, at the *humble* request of a subject.

In the United States, it is a CONSTITUTIONAL RIGHT, which the citizen may *demand*, and which the officers of government have no power to withhold.

The petition should state in *clear* and *precise* terms, the art, machine, manufacture, or composition of matter, or the improvement, of which the petitioner claims to be the inventor. Many law suits would be avoided if strict attention was paid to this suggestion.

Let the applicant bear in mind, that the petition is the *foundation* of his claim; that the letters patent, which issue in the manner hereinafter stated, will describe his invention in his own language, as used in his petition. The Act of Congress says the letters patent shall issue, "reciting the allegations and suggestions of the said petition, and giving a short description of the said invention, or discovery." This short description is copied from the petition. In the case of Boulton v. Bull, (so often referred to,) the patent was for "a new invented method of using an old engine in a more beneficial manner than theretofore, by the mechanical employment of certain principles;" and much time was spent, both at the bar, and on the bench, in endeavouring to find out *what* it was that the patentee claimed to have invented. In several other instances which could be mentioned, a want of precision in stating whether the discovery claimed was of the *original machine*, or only an *improvement*, has led to much useless litigation, and, in more than one instance, has endangered the patentees' rights.

THE OATH OR AFFIRMATION.

This petition should be accompanied by an oath, or affirmation, that the applicant doth verily believe, that he is the true inventor or discoverer of the art, machine, or improvement, for which he solicits a patent. This oath is a prerequisite, without which the patent ought not to issue. *But the validity of the patent, if issued, does not at all depend upon this oath.*

In the case of Whittemore v. Cutter, 1 Gallison's reports, 429, an action was instituted for a breach of a patent right in a machine for making of cotton and wool cards. One objection taken was, that the oath made by the inventor, did not conform to the Act of Congress. Judge Story observed, "the statute requires that the patentee shall swear 'that he is the true inventor or discoverer of the art, machine, or improvement.' The oath taken by Whittemore was, that he was the true *inventor, or improver*, of the machine." The taking of the oath was but a prerequisite to the granting of the patent, and in no degree essential to its validity. It might as well have been contended, that the patent was void, unless the thirty dollars required by the 11th section of the act, had been previously paid. Nevertheless, it is necessary to be very careful in drawing up this oath; for, the next rule to be laid down relative to the affidavit is, that,

Where the words of the patent or specification are doubtful as to the subject of the grant, the affidavit may be resorted to, in aid of the construction.

This was decided in the case of Pettibone v. Derringer, by Judge Washington. The patent was for "a new and useful improvement in musket, pistol and rifle barrels, by an auger called the spiral groove, or twisted screw auger." The specification stated that "the invention consisted in the manner of making the auger, or the particular form or construction of the same, as also the mode of application." The affidavit stated that "he (the applicant) verily believed that he was the first inventor of the improved method of making augers, or bits, for boring musket, pistol, and rifle barrels, as above described." Judge Washington remarked, that whether the want of an affidavit will avoid the patent, or will in all cases confine the patent to the invention stated in it, as the defendant's counsel have contended, are questions which need not be decided in this case; but there can be no doubt that when the construction of the patent and specification as to the subject of the grant is *doubtful*, the affidavit, if more precise, may be resorted to for explanation, and to remove ambiguity. It would seem to be particularly proper to do so, for restraining general expressions in the specification; as the oath required to be taken by the Act of Congress is, that the inventor does verily believe that he is the true inventor of the art, machine, or improvement, for which he solicits a patent.

4. If the applicant be a *resident Alien*, he is required, by the 1st section of the Act of Congress of the 17th of April, 1800, to swear, or affirm, "that such invention, art or discovery, hath not, to the best of his knowledge or belief, been known, or used, either in this, or any foreign country."

OF THE SPECIFICATION OR DESCRIPTION.

The next thing required by the Act of Congress is the *description*, or, as it is generally called, the *specification*; the words are these, "and shall deliver a written description of his invention, and of the manner of using, or process of compounding the same, in such full, clear, and exact terms, as to distinguish the same from all other things

before known, and to enable any person skilled in the art or science, of which it is a branch, or with which it is most nearly connected, to make, compound, and use the same. And in the case of any machine, he shall fully explain the principle, and the several modes, in which he has contemplated the application of that principle, or character, by which it may be distinguished from other inventions."

There is nothing in the statute of James which requires any specification, and for about a century after the passing of the act, none was required; but a clause or proviso is now generally inserted in the British patents; that is, "if the patentee shall not, within a stated time, particularly describe and ascertain the nature of the said invention, and in what manner the same is to be performed, by an instrument of writing under his hand and seal, and cause the same to be enrolled in the Court of Chancery, then they shall become void." See Harmar v. Playne, 11 East. rep. 101.

To pursue the order laid down in the Act of Congress, *the applicant must first give a description of his invention.* The public having a right to know, in precise terms, what it is that the applicant claims to have invented.

In M'Farlane v. Price, 1 Starkie's reports, 199, which was an action for infringing a patent for certain improvements in making umbrellas and parasols, Lord Ellenborough said, "the patentee in his specification, ought to inform the person who consults it, what is *new* and what is *old*. He should say, my improvement consists in *this*, describing it by words, if he can," &c.

And in Lowell v. Lewis, 1 Mason's reports, 187, Story, Justice, says, "I accede at once to the doctrine of the authority which has been cited (alluding to the above case) that the patentee is bound to describe, in full and exact terms, *in what his invention consists.*"

It would appear also that the specification should agree with the patent; which, as before shown, accords with the petition; and therefore it may be laid down as a rule, that *the specification must agree with the petition.*

Lord Cochrane obtained a patent for "a method, or methods, of more completely lighting cities, towns, and villages." The specification described certain improvements upon street lamps. Mr. Justice Blanc said, "I think this patent cannot be supported: it is in substance, a patent for an improvement in street lamps, and should have been so taken." Cochrane v. Smethurst, 1 Starkie's reports, 205. This case is quoted in 1 Mason's reports, 476, and approved by Judge Story.

A patent for an improved machine, must show precisely, in the specification, in what the improvement consists.

In the above mentioned case of Lowell v. Lewis, 1 Mason's reports, 188, Judge Story, to what is before quoted, adds, "and if it be for an improvement *only*, upon an existing machine, he should distinguish what is *new*, and what is *old*, in his specification, so that it may *clearly* appear for what the patent is granted."

In making this description no part of the invention must be omitted, the whole must be described. This is laid down in Buller's, N. P. [77.] "If the specification be, *in any part of it*, materially false or defective,

the patent is against law, and cannot be supported;" and again, "if any one part of the invention be not sufficiently described, the patent is void."

In the next place, the Act of Congress requires, that a description be given of the *manner of using*, or *process of compounding* the invention. In so doing the patentee must be careful not to omit *any thing* that is useful in the operation.

A patent was granted for making steel trusses, and it appeared that the patentee, in tempering the steel, rubbed it with tallow, which was of *some* use in the operation, and because this was omitted, the specification was held to be insufficient, and the patent was avoided. Liardet v. Johnson, cited by Mr. Justice Buller in Turner v. Winter, 1 Term Reports, 602.

In like manner, *the patentee must be on his guard not to insert in his specification unnecessary ingredients, which will not answer the purpose.*

Turner obtained a patent for producing a yellow colour for painting, for making white lead, and separating the mineral alkali from common salt; all by one process. One of the ingredients directed to be used was minium, which, it was contended, would not answer the purpose. Buller, J. observed:—"If he (the patentee) could only make it with two or three of the ingredients specified, and he has inserted others which will not answer the purpose, that will avoid the patent."

Again: *He must not conceal a more beneficial mode of working the invention.* It must be borne in mind, that the patentee makes a contract with the public, that in consideration of the protection afforded during the fourteen years, he will teach them the *whole process;* any concealment, therefore, would be a fraud upon the public.

W. Brown took out a patent for a machine, or machines, for the manufacture of bobbin-lace; and it appeared upon the trial of an action brought by Bovill, his assignee, v. Moore, for a breach of this patent right, that the machinery used, was assisted by bending together two of the teeth of the dividers, or making one larger than the rest, which was not described in the specification. Lord Chief Justice Gibbs remarked, "that if W. Brown, since he obtained his patent, had discovered an improvement, effected by bending the teeth, or adding a larger tooth, he might apply that improvement, and his patent would not be affected by his using his own machine in that improved state; but if, at the time when he obtained his patent, he was apprized of this more beneficial mode of working, and did not, by his specification, communicate this *more beneficial mode of working* to the public, that would have been a fraudulent concealment from the public, and would render his patent void. Bovill v. Moore, 2 Marshall's Reports, 211.

In the same case, Sir Vicary Gibbs says, "there is another consideration respecting the specification, which is also a material one, and that is, whether the patentee has given a full specification of his invention, not only one that will enable a workman to construct a machine answering to the patent, but one that will enable a workman to construct a machine answerable to the patent, *to the extent most*

beneficial within the knowledge of the patentee at the time: for a patentee who has invented a machine useful to the public, and can construct it in one way more extensive in its benefits than in another, and states in his specification only that mode which would be *least* beneficial, reserving to himself the *more* beneficial mode of practising it, although he will have so far answered the patent, as to describe in his specification a machine to which the patent extends, yet he will not have satisfied the law by communicating to the public the *most beneficial mode* he was then possessed of, for exercising the privilege granted to him."

In like manner, *the patentee must by his specification put the public in possession of the cheapest method of constructing and using the invention and discovery.*

This principle was recognized by Mr. Justice Buller in Turner v. Winter, 1 Term reports, 602, he says, "so if he makes the article for which the patent is granted, with *cheaper materials* than those which he has enumerated, although the latter will answer the purpose equally well, the patent is void, because he does not put the public in possession of his invention, or enable them to derive the same benefit which he himself does."

It will be proper here to observe, that in laying down the foregoing rules we have not taken at all into consideration the *motives* of the applicant, but have stated, generally, that if the specification be defective in any of the essential particulars before pointed out, that the letters patent are void. The reason is this; the monopoly is granted upon an *express condition* that the patentee shall make such a full disclosure of his secret as will enable the public, after the expiration of the term of exclusive privilege, by a bare inspection of the specification, to make and use the invention or discovery, in as full and ample a manner as the patentee made and used it. Now if such a disclosure be not made, the *condition is broken*, the consideration fails, and the *motives* of the patentee are immaterial. This is in perfect accordance with the principles of the common law, and the decisions of the British courts upon the English statute.

In the United States, no defect, or concealment, in a specification, will avoid a patent, unless it arise from an intention to deceive the public.

This important distinction between the American and English law, depends upon the peculiar terms of the act of Congress; the words of the third section, above quoted, being restrained by those of the sixth section, which are as follow: "that the defendant in any such action (an action brought for infringement) shall be permitted to plead the general issue, and give, in evidence, this act, and any special matter, of which notice in writing may have been given to the plaintiff, tending to prove that the specification does not contain the whole truth relative to his discovery, or that it contains more than is necessary to produce the described effect, which concealment and addition shall fully appear to have been made *for the purpose of deceiving the public;* or that the thing, thus secured by patent, was not originally discovered by the patentee, but had been in use, or had been described in some public work, anterior to the supposed discovery of the patentee; or

that he had surreptitiously obtained a patent for the discovery of another person: in either of which cases, judgment shall be rendered for the defendant, with costs, and the patent shall be declared void."

In 1813, this point came before the Circuit Court of the United States for the 1st circuit, Whittemore v. Cutter, 1 Gallison's Reports, 429. The plaintiff sued for a violation of his patent right for a machine for the making of cotton and wool cards, and after a verdict for the defendant, upon a motion for a new trial, this was one of the grounds reviewed. Judge Story uses the following language. "In order fully to understand the objection to this direction, it is necessary to advert to the third section of the act of 1793, which specifies the requisites to be complied with in procuring a patent, and the sixth section of the same act, which states certain defences, of which the defendant may avail himself to defeat the action, and to avoid the patent. The third section, among other things, requires the party applying for a patent, to deliver a written description of his invention, and of the manner of using, or process of compounding the same, in such full, clear, and exact terms, as to distinguish the same from all other things before known, and to enable any person skilled in the art or science, of which it is a branch, or with which it is most intimately connected, to make, compound, and use the same; and in the case of any machine, he shall fully explain the principle, and the several modes in which he has contemplated the application of that principle, or character, by which it may be distinguished from other inventions. The sixth section provides, among other things, that the defendant may give, in evidence, in his defence, that the specification filed by the plaintiff does not contain the whole truth relative to his discovery, or that it contains more than is necessary to produce the described effect, which concealment or addition, shall fully appear to have been made *for the purpose of deceiving the public.*"

"It is very clear, that the 6th section does not enumerate *all* the defences, of which the defendant may legally avail himself; for he may clearly give in evidence, that he never did the act attributed to him; that the patentee is an alien not entitled under the act; or, that he has a license or authority from the patentee. It is therefore argued, that if the specification be materially defective, or obscurely, or so loosely worded, that a skilful workman in that particular art, could not construct the machine, it is a good defence against the action, although no *intentional* deception has been practised. This is beyond all question, the doctrine of the common law; and it is founded in good reason; for the monopoly is granted upon the *express condition*, that the party shall make a full and explicit disclosure, so as to enable the public, at the expiration of his patent, to make and use the invention or improvement, in as ample and beneficial a manner, as the patentee himself. If therefore, it be so obscure, loose, and imperfect, that this cannot be done, it is defrauding the public of all the consideration, upon which the monopoly is granted. And the *motive* of the party, whether *innocent* or *otherwise*, becomes *immaterial*, because the public mischief remains the same. It is said, that the law is the same in the United States, notwithstanding the word-

ing of the 6th section; for there is a great distinction between a concealment of material parts, and a defective and ambiguous description of all the parts, and that in the latter case, although there may be no intentional concealment, yet the patent may be avoided for uncertainty, as to the subject matter of it. There is a considerable force in the distinction, at first view; and yet, upon more close consideration, it will be difficult to support it. What is a defective description, but a concealment of some parts, necessary to be known, in order to present a complete view of the mechanism? In the present case, the material defects were stated, among other things, to consist in a want of a specific description of the dimensions of the component parts, and of the shapes and position of the various knobs. Were these a concealment of material parts, or a defective and ambiguous disclosure of them? Could the Legislature have intended to pronounce, that the concealment of a material spring should not, *unless made with design to deceive the public*, avoid the patent, and yet, that an *obscure description* of the same spring, should *at all events* avoid it? It would be somewhat hazardous to attempt to sustain such a proposition. It was probably with a view to guard the public against the injury arising from defective specifications, that the statute requires the letters patent to be examined by the Attorney-General, and certified to be in conformity to the law, before the great seal is affixed to them. In point of practice, this must unavoidably be a very insufficient security, and the policy of the provision, that has changed the common law, may be very doubtful. This, however, is a consideration proper before *another* tribunal. *We* must administer the law as we find it. And, without going more at large into this point, we think, that the manifest intention of the Legislature was, *not to allow any defect or concealment in a specification to avoid the patent, unless it arose from an intention to deceive the public.* There is no ground therefore, on which we can support this objection."

Biographical Account of Alexander Wilson, M. D. *formerly Professor of Practical Astronomy in Glasgow, and the father of Type-founding in Scotland.*

Abstracted from a paper in the 'Annals of Philosophy,' for November, 1826.

Alexander Wilson, the subject of this memoir, was a younger son of Patrick Wilson, town-clerk of St. Andrews, and was born there in 1714. His father died whilst he was very young, and Alexander was brought up under the care of his mother, who was esteemed for her prudence, virtue and piety. After the usual preparation in different schools, he entered the College of St. Andrews, where he made great progress in literature and the sciences, and in his 19th year, received the degree of Master of Arts.

His favourite study was natural philosophy, particularly the branches of optics and astronomy. From his earliest years, he ex-

hibited a fondness for drawing, modelling of figures, engraving on copper, and other ingenious arts. Whilst yet a boy, his self directed efforts enabled him to produce specimens of ingenuity, which, in the opinion of real judges, evinced uncommon natural talents.

On leaving college, he was put as an apprentice to a surgeon and apothecary. At this period, he found a patron in Dr. George Martine, who was then engaged in preparing those essays on heat, which have given celebrity to his name. The construction and graduation of accurate thermometers, was at this period, but little understood in Britain; Dr. Martine called the attention of Wilson to this fact, and although the subject was quite new to him, he soon acquired great address in the working of glass, by the lamp and blowpipe, so as to give it the necessary form; and also, in dividing the scales, with accuracy and elegance.

About this period, he discovered the principles of the solar microscope, and exhibited to many of his friends, in a dark chamber, the images of small objects, enormously magnified, by the sun's rays admitted through a small hole in a shutter. A similar apparatus was subsequently invented, with some improvements, by Mr. Lieberkin, by whom it was introduced to the public, and received as a valuable optical instrument.

Whilst employed in such researches, Wilson proposed to some of his philosophical friends, the idea of forming a burning mirror, by means of plane glasses, so as to concentrate the heat reflected by them, at a great distance; he did not however possess the necessary funds for the completion of his scheme. He was uninformed of the fact, that Kircher had hit upon the same idea, as was also M. de Buffon, who, some years afterwards, constructed a magnificent apparatus upon the same principle, with such success, as to give an air of probability to the account of the burning of the Roman galleys, by Archimedes.

In 1737, Mr. Wilson removed to London, to seek for employment in the medical profession. He soon obtained a situation with a French surgeon and apothecary, who received him into his family. He was there introduced to several noblemen, and other persons of distinction. Lord Isla bestowed upon him many marks of favour. Wilson was particularly gratified, by the examination of the valuable philosophical apparatus, which his lordship possessed, and was happy in being able to present to him, and to his friends, thermometers of different kinds, more perfect and elegant, than had hitherto been seen in London.

Mr. Wilson continued for about eighteen months, to pass his time with much satisfaction in the house of his master, whose confidence and esteem he had acquired, manifesting that serenity of temper, and felicity of disposition, which distinguished him throughout his life; and enjoying the satisfaction of keeping up his acquaintance with persons of a philosophical cast. Whilst he thought that he was comfortably preparing himself for his entrance into the world, an accidental circumstance, gave a new direction to his genius, and led to an entire change in his professional pursuits. This was a transient visit with a friend to a type-foundry, where he carefully examined the curious

contrivances made use of in that business. After some reflection, he imagined, that a great improvement might be made, which would amply reward the inventor. He communicated his ideas to a friend from St. Andrews, who was but a little older than himself, and who possessed ingenuity, constancy, and enterprise; and these young adventurers, determined to unite their exertions in prosecuting the business of letter founding. This design they soon carried into effect; at first at St. Andrews, and two years afterwards, on an enlarged scale, in the neighbourhood of Glasgow.

Mr. Wilson's talents, as an artist, became every year more conspicuous. A font of new Greek types, which he executed for the University press, upon a highly improved model, manifested great taste, and increased his celebrity. Whilst actively engaged in this business, he still found some time to devote to other objects; particularly to the art of constructing reflecting telescopes, in which his efforts were eminently successful.

In conjunction with Mr. Thomas Melville, a literary and scientific friend, he, in the year 1749, undertook to prosecute some experiments, which he had suggested, in order to ascertain the temperature of the higher regions of the atmosphere. To accomplish this, they constructed half a dozen paper kites, one of which they raised, and then hooked its string to the back of a second, which was succeeded by three similar attachments; thus elevating the uppermost kite to such a height, that it was occasionally lost among the white summer clouds. To the kites, were attached thermometers, which were to fall by the gradual burning of a match line.

In the year 1752, Mr. Wilson, who had married the daughter of William Sharp, a merchant of St. Andrews, removed with his family to Glasgow. He here invented the hydrostatical glass bubbles, for ascertaining the strength of spirits, and which have proved to be equally accurate and commodious; in a discourse respecting these, he showed how a single bubble might be used, to ascertain the specific gravity of fluids of the same kind (as of the water of different springs) by altering the temperature of the fluid, until the bubble became stationary, and then estimating the differences in their specific gravity, by degrees of the thermometer.

In 1758 he read a discourse upon the pendulum, and exhibited a small spring clock, with a balance pendulum which he had contrived, and which, on one trial, did not vary more than a second, in forty hours, when compared with an exact astronomical clock.

Soon after this, he greatly improved the thermometer, by having the capillary bore made elliptical, instead of round; so that the thread of quicksilver was much more visible, than in a cylindrical bore of the same capacity. He also conceived the design of converting the thermometer into a marine barometer, by ascertaining the difference of the boiling point of water, under the variable pressure of the atmosphere.

In the year 1760, Mr. Wilson was appointed professor of practical astronomy in the University of Glasgow; which professorship had been newly created, in consequence of its obtaining by legacy, an

excellent astronomical apparatus, for the reception of which an observatory had been built. To this new office, he was admitted by the unanimous and cordial welcome of the faculty.

His two eldest sons, who had by this time entered upon a course of liberal education, soon took upon them the care of the foundry, which they further enlarged and improved; and the father had the happiness in advanced age, of enjoying the reward of his early diligence, in seeing the business rising in their hands to the highest reputation, both at home, and abroad.

In 1763, he received the honorary degree of doctor of medicine, from his alma mater.

In his observatory, he resumed his labours for the improvement of the reflecting telescope, and frequently regretted that some crowned head, or wealthy association, did not supply the means for making instruments of large dimensions, for the purpose of more perfectly exploring the heavens. The more recent labours, and brilliant success of Herschell, have fully justified his anticipation of what might be accomplished on this subject.

In 1769, Dr. Wilson made the discovery concerning the solar spots, on which he treated in the Philosophical Transactions for 1774. From the royal society of Copenhagen, he received a prize medal of gold, as a reward for this discovery.

His theory with regard to the solar spots, although it added to his reputation, encountered considerable opposition. After a silence of nearly ten years, he published a second paper upon this subject, wherein, upon the authority of numerous observations, he maintained the reality of his discovery, with an entire conviction of its truth. The amount of it is, "that the spots are *cavities*, or *depressions* in that immensely resplendent substance which invests the body of the sun to a certain depth; that the dark nucleus of the spot, is at the bottom of this excavation, which commonly extends downwards to a space equal to the semi-diameter of our globe; the shady or dusky zone which surrounds the nucleus, is nothing but the sloping sides of the excavation, reaching from the sun's general surface downward, to the nucleus or bottom." All this he has demonstrated by a strict induction, drawn from observations of the spots as they traverse the sun's disc.

Dr. Wilson continued to an advanced age, in the active pursuit of his duties, which were also his delight. He likewise continued to enjoy the blessing of uninterrupted health. In 1784, at the recommendation of the University, the king appointed his second son, Patrick Wilson, to be assistant and successor to his father; a circumstance which greatly brightened the consolations he enjoyed in the evening of life.

In March, and April, 1786, when he had nearly completed his seventy-second year, it became apparent that his constitution was fast declining. After a gradual and easy decay, which he bore with the utmost resignation, and amidst the tender solicitudes of his surrounding family, he at last expired in their arms, on the 16th day of October.

The private character of Dr. Wilson was amiable to an uncommon degree. From his early youth, to venerable age, he was actuated by a rational and steadfast piety, enlivened by those gracious assurances which carry our hopes and prospects beyond the grave, and sweeten the lot of human life. In his temper, meekness and humility were happily combined with habitual cheerfulness; and his affections flowed in the warmest current immediately from the heart. His looks, as well as his conversation and demeanour, constantly indicated a soul full of innocence and benignity, in harmony with itself, and aspiring to be so with all around it.

A description of the improved Turning Lathe, as made by MASON *and* TYLER, *of this city. By the Editor.*

[WITH A PLATE.]

At the second annual exhibition of the Franklin Institute, a turning lathe made by Mr. Rufus Tyler, excited much attention among those who were judges of that instrument, both on account of the perfection of the workmanship, and the improvements in its construction. In respect to the former, it might safely be compared with the most perfect productions of the workshops of England or France. The sliding parts, traversed with an equability and ease, which left nothing to be desired in that particular. The front centre, which, (as may be seen in the plate,) was a sliding bolt, might be used without the tightening screw, in turning steel, or other metals; and, in fact, the large and small lathes in Mason and Tyler's workshop, although provided with tightening screws, are generally used without them. The cast-steel screw by which this centre was moved, might be worked its whole length without the slightest shake, *wabble*, or inequality; the centring appeared to be absolutely perfect, and good workmen are well aware of the difficulty of attaining this high degree of accuracy. In constructing this lathe, Mr. Tyler availed himself, not only of his own experience, but of the improvements made by Messrs. Lukens, Mason, Clarke, Baldwin, and others among our best mechanicians. Simplicity of structure was particularly consulted, as the main object was to produce a lathe adapted to general use; it is represented, therefore, without those appendages which are designed for particular purposes only, such as guides for cutting screws, and eccentric and oval chucks; these, however, may, of course, be attached to it when desired.

The accompanying plate was engraved for Carey and Lea's edition of Nicholson's Mechanic; in which work, a description is also given of the turning apparatus of Maudslay, and of Smart, of London, which may be consulted for the manner of applying the lathe to certain particular uses. We have somewhat enlarged the description of Mr. Tyler's lathe, as we know that it will be acceptable to many of our readers.

A, The shears, of cast iron, with three feet, which serve to connect

them firmly at a proper distance from each other, leaving the spaces between them unobstructed by cross bolts, and permitting the sliding head and rest to be taken out, without detaching their holdfasts.

B, The standing head, cast in the usual way.

E, The sliding head.

F, The front centre sliding bolt. This is a cylinder, sliding in a hollow cylinder, which is formed in the top of the sliding head. It is moved backwards and forwards, by means of a left handed screw which passes into it.

G, The rest, cast with a groove underneath, to receive the head of its holdfast.

Fig. 1.—A section of the standing head, with its mandrel and drill chuck. The drill chuck C, is slightly conical, and is made fast in the mandrel by the key D.

The drill chuck has a conical hole, which in the figure is represented as containing a steel point. When drills are fitted into this hole, they are sufficiently firm for ordinary drilling, whilst they will generally turn round, from catching, or other extraordinary resistance, and thus be preserved from breaking.

The mandrel runs in a conical steel collar, which may be seen in the section.

The conical end of the back centre is truncated; it works against a hardened die let into the mandrel for that purpose, and sustains the pressure in drilling, &c. preventing that great increase of friction which is produced when the ordinary sharp angled cone is employed.

The conical end of the back centre is made somewhat more acute than the opening in the mandrel, which lessens the friction, and gives free admission to oil.

Fig 2.—E, A section of the sliding head. The front centre is represented as inserted into the bolt at F. At the opposite end is seen the left handed screw, which is attached by a collar to the hollow cylinder of the head, with which it forms a case, which secures the bolt and screw from chips and dust.

Fig 3.—An end view of the shears and foot, with the sliding head and its holdfast.

The inner edges of the shears are bevelled, and the sliding head has an angular piece screwed upon the bottom, which is nicely fitted into the bevel of the shears. Should any wearing take place, this is compensated by a thin piece of metal inserted between this bevel piece and the head.

Fig. 4.—A screw chuck, to be substituted for the drill chuck, in fig. 1.

Fig. 5.—A section of the bed of the rest, showing the manner in which the groove is formed.

Fig. 6.—An end view of the treadle, with its upright shaft H braced, and the pitman I, attached to it.

The form given to the pitman at K, where it fits on to the crank, admits of its disengaging itself when the treadle is obstructed, whilst it is securely retained in its place under ordinary circumstances.

A crank, with a short pitman, turns one of its dead points much

more quickly than the other; in the arrangement of the crank in this lathe, advantage is taken of that peculiarity; the slower turn takes place at the bottom of the tread, and the too quick return upon the foot, which occurs in the common mode, is consequently obviated.

The lathe is most conveniently fixed in the way represented in the plate; that is, screwed to a table, which is supported at each end by a case with drawers, leaving a space between, for the wheel and treadle.

The wheel is of cast iron, with the arms curved to prevent their breaking from contraction, at the time of casting. The holes in the arms, are to admit of screws to affix a smaller wheel, when a slow motion is required.

In the old mode of fixing the treadles of lathes, the lever was of the third kind, and the crank was consequently made long. In the modern mode, the lever is of the second kind, and the crank must be proportionably short, or the rise for the foot will be too great.

This lathe is equally suitable to the use of the professed turner, and the amateur, as it is handsome, strong, easily adapted to various purposes, and not liable to get out of order.

For a description of the slide rest, adapted to this, or other lathes, see Vol. 2, pp. 104, 369.

On female birds assuming the male plumage.

The editor of "The Edinburgh New Philosophical Journal," has annexed the following interesting note to a translation of M. Isidore Geoffroy Saint Hilaire's memoir, "on Female Pheasants assuming the male plumage."

The interesting fact of female birds assuming the plumage of the male, was, in modern times, first attended to by the celebrated J. Hunter, who, in a memoir on this subject in the Philosophical Transactions of London, describes a hen pheasant, and pea-hen, which had, in old age, assumed the male plumage. M. I. G. St. Hilaire, in the preceding memoir, says, that of the many pea-hens in the menagerie at Paris, no instance occurred of the pea-hen assuming the male plumage; a fact which shows that such a change is rarely met with in this fowl. In the museum of this University there is a fine specimen of the pea-hen, with the male plumage, presented to the museum by the Dutchess of Buccleugh. In the note accompanying the gift, it is said that the change was effected during the course of a few years. The following description will convey an idea of the degree of change effected in this individual. The head and the neck have assumed the same green and blue tints which characterize the male; the breast and belly also have the same deep colours. As in the male, the primaries are pale-brown, and a patch upon the wing bright-green. The dorsal feathers, however, are still more or less mottled with gray; and the green which they have partially assumed, is lighter than in the male, and not blended with the coppery hue which in his plumage ex-

tends from the middle of the back, to the rump. The rump feathers are elongated, some of them to the length of eighteen inches, but the train formed by them is scanty, and the ocellar spots are neither so large nor so varied as in the male. The ordinary tubercles on the tarsi of the female, have been developed into thick regular conical spurs, about half the length of those of the male. In short, the change is so much advanced, that after another month it would probably have been complete.

In the museum of the University there is a specimen of the female pheasant with the male plumage, presented some years ago by Dr. Hope. The only differences which the plumage of this individual exhibits, when contrasted with the male bird, are the following: first, the tail feathers, are shorter than those of an adult male, although considerably longer than those of an ordinary female; secondly, the lustre of the colours in general, is not quite so vivid as in the male, especially on the back of the wings. There is no appearance of spurs.

Sometimes the same sort of apparent change of sex is observed among domestic poultry. Mr. Neill, at Canon-mills, had a black hen, of what is called the French breed, which in her twelfth year ceased to lay eggs, and gradually assumed somewhat the appearance, and, to a considerable degree, the manner of a cock. The principal change of plumage consisted in the tuft on the head becoming thinner, and showing some upright, stray feathers, and in a single elongated feather, projecting from the tail. The spurs were larger than usual in hens, but these had probably been increasing for some years. The change of manner in the bird was quite remarkable; she strutted about in an overbearing way, with a firm pace, and raised tail; she formed a party among the fowls, which she led separate from the cock, and she roosted apart from him; she became very voracious, and when food was set down (losing all resemblance in this instance, to the generous male) she beat off the other hens: when, in these cases, she came in contact with the cock, she stared at him, but without making any attack. She soon became very fat, and died within a few months, seemingly of over fatness. Her cry was altered, but had little resemblance to the crowing of the cock; less, indeed, than is sometimes noticed in young hens.

In the British museum there are several specimens of pheasants, which have undergone this change; and similar instances are recorded of female turkeys, partridges, pigeons, ducks, &c.

The Moon and its Inhabitants.

Olbers considers it as very probable, that the Moon is inhabited by rational creatures; and that its surface is more or less covered with a vegetation not very dissimilar to that of our own earth. Gruithuisen maintains, that he has discovered by means of his telescope, great artificial works in the Moon, erected by the Lunarians; and very lately, another observer maintains, from actual observation, that great

edifices do exist in the Moon. Noggerath, the geologist, does not deny the accuracy of the descriptions published by Gruithuisen, but maintains, that all these appearances are owing to vast whin dykes, or trap veins, rising above the general lunar surface.

Gruithuisen, in a conversation with the great astronomer Gauss, after describing the regular figures he had discovered in the Moon, spoke of the possibility of a correspondence with the inhabitants of the Moon. He brought, he says, to Gauss's recollection, the idea he had commuuicated many years ago to Zimmerman. Gauss answered, that the plan of erecting a geometrical figure on the plains of Siberia, corresponded with his opinion, because, according to his view, a correspondence with the inhabitants of the Moon, could only be begun by means of such mathematical contemplations and ideas, which we, and they, must have in common. The vast circular hollows in the Moon, have been by some, considered as evidences of volcanic action, but they differ so much, in form and structure, from volcanic craters, that many are now of opinion, and with reason, that they are vast circular valleys.—[*Edin. New. Phil. Jour.*

In the number of the "Annals of Philosophy," for December last, there is a paper by the Revd. J. B. Emmett; in which he notices some telescopical appearances of the Moon. He observed certain continued lines on the northern boundary of *Palus Mœotis*, of Hevelius, which have the appearance of rivers; and also numerous other similar objects on the southern parts, upon which he is pursuing his observations with a view to trace them to their full extent; and to free them from the illusions arising from the shadows of ridges, and other objects of a similar nature; after which, he means to trace their length by the micrometer. He observes, that "to see these appearances, the air should be in such a state, that good and steady discs of the stars may be obtained; the telescope must have abundance of light, a high power, and be very steadily mounted. Under these circumstances, it frequently happens, that the whole cannot be traced at one view. The best age of the Moon I have found to be, between eight and twelve days after conjunction." "About the S. parts, are similar appearances, but more complicated; they run towards Paludes, to which they seem to be joined; forming in their course several spaces, which have the appearance of small lakes."

On coating Iron with Copper, and on burning Anthracite in Steam Engine Furnaces.

TO THE EDITOR OF THE FRANKLIN JOURNAL.

Lebanon, February 24th, 1827.

Sir,—When I wrote to you on the subject of coating iron with copper, I had not that object so much in view, as the making a hit at the host of patent-mongers, who so frequently abuse the privileges intended for ingenious and industrious men, by the patent laws, in

taking out patents for alleged discoveries and inventions, which embrace processes long known, and many of them in general use; thus defrauding the public, and annoying the industrious and ingenious mechanic.

With regard to the coating of iron with copper, I will briefly state, that I am no coppersmith, and not much of a chemist, but my experience on the subject, is this; during the last war, I was largely engaged in the manufacture of iron, and was applied to roll a quantity of sheet copper for the sheathing of vessels, and other purposes; and when it was rolled to the proper thickness, in order to give it that bright appearance exhibited on the face of the imported copper, I prepared a cistern of water, and when the sheets were heated to a common red heat, plunged them in, which removed the scale, or oxide, from the surface, and answered the two fold purpose, of leaving it bright, and soft. After finishing the copper, we resumed our usual occupation of rolling sheet iron—the workmen in removing the scraps or trimmings of the sheet iron, from the shears to the scrap heap, let some of them accidently fall into the cistern, and remain there: some time afterwards, when I was about to have the cistern removed, I noticed the scraps in the bottom, and that they had the appearance of copper; I took them out, and found them completely coated; I then threw some more into the cistern, and after they had been there some time, I do not recollect how long, I examined them, and found them likewise coated; I then concluded, there could be no mistake in the business, and thus the thing has remained, without any further trials. I have occasionally mentioned it to individuals, but do not know that any of them ever repeated the experiment, or made any use of the hint.

In your remarks on the use of anthracite coal, you state it as your belief, that the engine at Phœnix works, was not constructed with a view to its use; as I had an agency in the erection of those works, I think it may not be improper for me to state, that they were constructed with a particular view to that object. I do not however pretend to any great secret on the subject; to use anthracite for generating steam, it is only necessary to know, that the flame, or heat, will not extend so far from the grate, as that from wood or bituminous coal, so as to be sufficiently intense to raise steam; consequently, the boilers and flues must be made shorter, or, if cylinder boilers are used of the usual length, the fire beds and grates, must be placed at each end of them, which is the case at Phœnixville; any additional length of boiler, above what is really necessary, operates, in all cases, to act as a condensor upon the remaining part. I have put up a number of steam engines of the largest class in the western country, and some on this side of the mountains, and I can with truth say, I know of no fuel that will generate steam so fast as the anthracite coal, when properly applied.

Respectfully yours,

JOSHUA MALIN.

The Editor is particularly gratified with the remarks of Mr. Malin, on the subject of burning anthracite, under the boilers of steam engines. Several plans have been devised, and some have been patented, with a view to burning this coal in contact with the boiler; to attain this object, the fire is fed from above, in order to keep the coal piled against the lower part of the boiler. The editor does not know that this plan has been essayed in the large way, he is however convinced, that it must end in abortion: it is impossible to keep the coal ignited in contact with a good conductor, excepting that conductor may be heated to redness; steam engine boilers must remain of the same temperature, with the water contained in them, about 212° of Fahrenheit; an unignited mass of coal, which is one among the very worst conductors of heat, must, under such a plan, be perpetually interposed between the burning fuel and the boiler. The method indicated by our correspondent, appears to be founded on correct reasoning, and the practice seems to justify this conclusion.

With respect to the coating of copper, upon the shreds of iron, it is a well known fact, that this will take place when iron is immersed in solutions of the *salts* of copper; the oxide alone is insoluble; in troughs used in manufactories for a considerable length of time, there are many sources from which a portion of acid may find its way into the water, in sufficient quantity to have produced the effect above spoken of; but the coating would never become thick, or be durable. At the copper works at Anglesea, and elsewhere, it is the practice to put shreds of iron into the water which runs from the mines; this water is impregnated with salts of copper, the acid of which, dissolves a portion of the iron, whilst the copper is deposited; this process continues until the whole of the iron disappears, and a corresponding portion of copper remains, giving to the unscientific, the idea of the transmutation of iron into copper. By this process, a large quantity of copper is saved, which was formerly allowed to run to waste.

On Automata and Androides.

BY THE EDITOR.

In the last number of this Journal we made some remarks upon the chess-player, exhibited by Mr. Maelzel; since the publication of that paper, the question has been repeatedly asked, why we did not offer some explanation of the manner in which the concealed agent might be informed of the moves made upon the board? It was not our design to enter into the minutia of the structure, but only to present some particulars with respect to the history of the exhibition, which had not been previously published, and to give some additional force to the opinion, that the intellectual direction of the figure, is given by an agent *within* the commode. For ourselves we confess that the proof is that of *Reductio ad Absurdum;* as every method which our imagination could supply, or which has been suggested by others, must appear totally inadequate to the production of the complicated motions

of the figure, in the judgment of any one practically skilled in mechanism.

Admitting the question to be settled, respecting the *first mover*, the details are easy; several modes have been suggested, by which the moves may be perceived, and some plans have been recently brought forward as novelties, which have long been before the public.

In the *Dictionnaire Encyclopédique*, published in 1792, there is a quotation on this subject, from a work of *Decremps*, entitled *Magie Blanche dévoilée*, to the following effect:—"It remains to explain by what means the dwarf concealed in the commode, could know the moves of his antagonist. There are, however, several modes in which this may be effected; a small magnet may be concealed in each of the chess-men, and under each square of the board, there may be a very sensible needle, which by its action will indicate the squares which are concerned in each move; or each square may be mentally numbered, and either by the position and number of the fingers, or by the pronunciation of certain words, information may be communicated; or the chess-board may be made partially transparent, which, whilst it might perfectly prevent a view from the outside, should enable the person within, to perceive the moves."

The author of "An attempt to analyse the Automaton Chess-player," has suggested, that one of the eyes of the figure, may serve as the lens of a camera obscura, by means of which the board may be examined; and we will add, that the chess board may be perforated in the centre of each square; the openings not being larger than a needle-point, would be unperceived even if closely examined, whilst the placing of a piece upon them, would be seen from within.

We have not noticed the idea, that the agent may leave the commode, and pass into the figure; we think the nature of the exhibition forbids this movement, that it is altogether unnecessary, and in fact impossible. The portion of light required, may be readily admitted at the back of the commode.

With respect to the general merits of Mr. Maelzel's exhibition, the testimony of the authors of the *Dictionnaire Technologique*, is worthy of attention. Paris has been the emporium of such exhibitions, and the publications respecting their structure, have been more numerous, and more complete there, than in any other place. These gentlemen say:—"The celebrated mechanician, Mr. Maelzel, lately exhibited in Paris, several automatons of the most perfect execution. We observed with much gratification his little rope dancers, execute with address, several feats which are with difficulty accomplished by the most expert performers."

We will now proceed to the fulfilment of our promise, to give some account of the most remarkable Automata and Androides of ancient and modern times.

Mankind have in every age, and in all countries, both savage and civilized, manifested a fondness for imitating the forms of man and of other animals; this is evinced as well in the rude sculptures of the barbarian, as in the breathing statues of polished Greece; and where, to a resemblance of the form, has been added an imitation of the sounds,

or motions, which distinguish living beings, the interest excited has been proportionally increased. If the ancient accounts of speaking and of moving figures, must not be considered as altogether fabulous, they should at least be received with great caution. The marvellous has reached us, but the simple truth is obscured in the haze which envelops all distant objects. We are told that Dædalus, an Athenian, was not only the inventor of the wedge, the axe, the level, and of many other mechanical instruments, but that he was also the first who applied sails to ships, which enabled him, without the oars, or the paddles, which had been formerly employed, to traverse the ocean, and, as it were, to fly from place to place, by means of his canvass wings; to this circumstance we are probably indebted for the story of his having invented wings, with which he fled from Crete to Sicily, to avoid the rage of Minos, whilst his son Icarus who attempted to accompany his father, was, in consequence of the failure of his wings, drowned in the sea. The following passage from 'Goguet's Origin of Laws, Arts and Sciences,' will serve to illustrate these remarks. "Sculpture remained long in this state among the Greeks. They reckon more than three hundred years from Cecrops to the ages in which they made Dædalus live. It was then that the Greek artists began to recognise the deformities, and the want of agreeableness, in the ancient statues. They thought they could make better. Dædalus, (that is to say, the sculptors who appeared in the ages in which they placed that artist,) in copying the Egyptian models, did not stick to them servilely. They tried to correct the defects, and succeeded, at least in part. Nature was the model which they proposed. The faces and the eyes of ancient statues had no expression. The artists, of whom I speak, studied to give it them; they detached from the body the arms and the legs, put them in action, and gave them various attitudes. Their statues appeared with graces which they had not yet seen in these sort of works. They were so struck at it, that antiquity said of the statues of Dædalus, that they appeared animated, moved and walked of themselves; exaggerations which show the happy change which was then made in the Greek sculpture."

Although these statues so far excelled those of preceding ages, as to cause it to be reported that they moved and walked, it appears that this admiration resulted entirely from the ignorance of the age in which they were produced; for Pausanias, in whose time some of them were still in existence, says that they were miserable productions, the parts being badly proportioned; and Plato observes, that the sculptor who should make statues in the taste of those of Dædalus, would render himself ridiculous: he however relates the account of their walking, and that to prevent them from doing so, it was found necessary to tie them.

Many of the ancient oracles proceeded from figures which appeared to speak, and sometimes to move; the history of these would, we believe, more properly belong to the history of priestcraft, than to that of ingenious mechanical inventions; the credulity of most of those persons who consulted them, rendered deception an easy task; and we doubt not, that could a complete account be obtained of the manner

in which the sounds were conveyed, and the motions produced, they would appear trifling, when compared with our invisible ladies, and many other similar contrivances of our own times. In the fourth century, when Bishop Theophilus broke to pieces the statues at Alexandria, he found some which were hollow, and placed in such manner against a wall, that a priest could slip unperceived behind them, and speak to the ignorant populace through their mouths.

It appears that small Automata, or puppets, were common among the Greeks, and were from Greece, introduced among the Romans. These were so constructed as to move by internal springs, so as to run upon a table; as they advanced, they moved their hands, heads, and eyes; and Aristotle speaks of some of them which performed these motions in a very natural manner. These were much used at their public shows. At a period when clock work was unknown, there is no reason to suppose that these movements were complex or perfect: they most probably resembled the Chinese toys, which in the form of men, beasts, ships, &c., move upon wheels, by the action of a spiral spring.

We are told, that as long ago as 400 years before Christ, Archytas of Tarentum, a Pythagorean philosopher, made a wooden pigeon that could fly. Aulus Gellius, quotes it from Favorinus, but neither of them have attempted to explain the mode of its action. Aulus Gellius, however, states that it flew by mechanical means.

Cardan mentions an image, holding in its hand a golden apple, beautifully ornamented with costly jewels, and which if any man offered to take, the statue immediately shot him to death; the touching of the apple serving to discharge numerous arrows concealed in various parts of the body of the figure.

Friar Bacon, and Albertus Magnus, are both celebrated for their Androides. The story of the brazen head of the former, is well known. From the genius of the constructor, it was undoubtedly well calculated to excite the surprise of his contemporaries, and to draw down upon him the imputation of dealing with the devil.

Albertus Magnus formed an artificial man; in the construction of which, he is said to have employed thirty years. This figure was broken to pieces by the fanatical monk, Aquinas, who, it is said, went to see it with a determination so to do, in order that he might boast, how in one minute, he had destroyed the labour of thirty years.

Kircher, Porta, Wilkins and others, relate the story of Muller of Nuremburg, commonly called Regiomontanus, having constructed a wooden eagle, which flew from the city of Nuremburg aloft in the air, met the emperor Maximilian at a distance, coming towards it, and, after saluting him, returned again, waiting on him to the city gates. This account carries with it too much the air of romance, to obtain credit at the present day. Some of the writers who mention the eagle, have made the emperor Charles the V. the hero of the story. Charles was the grandson of Maximilian, and was not born until 60 years after the death of Muller. This artist is also said to have made an iron fly, which at a feast to which he had invited his friends, flew from his hand, and taking a circuit round the room, returned to it again, to the

great astonishment of the guests. The whole was probably a magnetic trick, for which purpose the fly was formed of iron, and its action is undoubtedly related with that exaggeration, which in similar cases, is so common as almost to be universal.

We have selected a few from among many accounts of mechanical contrivances, which we deem either fabulous, exaggerated, or the work of charlatans; our next number will contain such as are more modern, the structure of which is well understood, or their action satisfactorily authenticated.

On making Inking-rollers, as a substitute for Balls, in Printing.

BY THE EDITOR.

In our first volume, page 305, we gave some account of the Dutch process of making an elastic composition for inking rollers. Since that period, rollers have been substituted for balls, at a great number of presses in this city. Every innovation of this kind, whatever may be its intrinsic worth, has to struggle into use, over the strong prejudices which are engendered by long continued habit. The old printing press preserved its form and its structure nearly unchanged, for ages; and although it is now universally confessed, that this instrument in consequence of the changes it has recently undergone, affords one of the most striking examples of the successful application of mechanical ingenuity; not only executing the work more perfectly than the old press, but greatly abridging the labour of the pressman; this triumph was not gained without a severe struggle.

Some of our best printers are already convinced, that work can be done better with the roller than with the ball; and it is evident that the labour is much lessened by its use; among the journeymen, however, there is much contrariety of opinion, and habit gives to them a strong bias in favour of the old practice; yet, judging from what we have seen, we think that the roller stands a fair chance of fighting its way into favour.

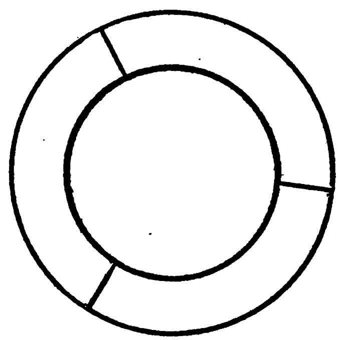
The rollers have not yet been made here, with that truth which is necessary to their perfect operation; they ought to be cylinders; but if the circle were not absolutely perfect, this defect would be less important, than any deviation from a straight line, lengthwise; the roller reaches across the whole form, and should touch the faces of the types with an equable force; for although it is elastic, this elasticity will not compensate for any sensible deviation from straightness in the roller.

To attain the necessary degree of perfection in the form of the roller, it is requisite that the mould in which it is cast, should be correctly made, and that it be of a material which will retain its form, and to which the composition will not adhere. Most of those which have been used here, have been made of wood; and had good close grained mahogany been taken, it would have answered the purpose very well,

after filling the grain with some resinous composition: there is scarcely any other kind of wood, equally hard and close grained, which is so little apt to *cast* as mahogany; the workmen, however, have tried inferior species of wood, and have consequently failed. An ingenious mechanic of this city undertook to make moulds of brass; of these he cast several pair; they were half cylinders, about three feet in length, three inches in diameter, and $\frac{1}{4}$ inch in thickness; in the casting, he succeeded remarkably well; and in order to bore them out, they were soft-soldered together, and firmly clamped; one pair was bored, but upon separating them, it was found that they had *sprung* in both directions, so that when put together, they formed an oval, instead of a circle, and would not come close on the edges. The Editor was consulted as to the cause of this springing, and the means of preventing it; but in this, as in many other cases, it was more easy to discover the cause of the evil, than to apply a remedy. In boring brass, the angle of the cutter must be very obtuse; and whilst it cuts, it also acts as a burnisher, closing the pores of the metal and stretching the surface which it abrades. The thickness of the cast moulds was not sufficient to resist the effect of this stretching, and they consequently sprung open: the result was, that they were abandoned, as it was thought that the labour of finishing them in any other way, would exceed their value.

It now became desirable to devise some easy method of forming moulds for immediate use. The editor suggested the employment of plaster of Paris; he has not yet heard how this has succeeded, but, if properly managed, it cannot fail to answer the purpose.

The manner of casting plaster moulds is known to a great number of workmen; we cannot, on the present occasion, enter into any detail upon this subject, but will do so at an early period.



For the purpose of casting a cylinder, the mould ought to be divided into three segments, in the manner represented in the diagram, as it is then readily separated from the article cast in it, which is not the case when it consists of two segments only.

Plaster moulds of the length required for inking rollers, ought to be made nearly two inches in thickness; they may be strengthened by passing stiff rods of iron lengthwise through the middle of each section. After the plaster is cast, four or five days will be required to dry it perfectly: it may then be saturated with the composition of linseed oil and beeswax, or of linseed oil and rosin, described in the paper of D'Arcet & Thenard, p. 276. vol. 2 of this Journal. The plaster must be warmed, with the precautions there recommended, as if heated too highly, it will be rendered rotten. Where time is allowed, boiled linseed oil alone,

is the best article for saturating plaster moulds; successive coats are to be laid on, until it is no longer absorbed; the moulds may be then exposed to the action of the sun, or kept in a warm place, until the oil is dry. This will give to them a dark brownish yellow colour, a smooth surface, and a texture resembling earthenware; in this state there is little danger of their chipping, or being otherwise defaced.

In order to form the plaster mould, a cylinder of wood must be turned, of the diameter of the intended roller, and several inches more in length. The composition of which the rollers are made, contracts in length very considerably, after being cast, before it becomes set; for this, allowance must of course be made in the length of the moulds.

Experiments and observations on some alloys of Platinum. By Thos. Cooper, M. D. *President of the South Carolina College.*

TO THE EDITOR OF THE FRANKLIN JOURNAL.

College: Columbia, South Carolina, Feb. 24, 1827.

Dear Sir—I read always with great satisfaction your very useful publication, the *Franklin Journal.* It deserves encouragement, and I hope it will meet with it.

You gave us some time ago, a process from some German chemist, for making a gold-coloured alloy, by means of virgin platinum. I tried the proportions indicated with pure malleable platinum, and found the recipe worthless. No furnace or forge, urged with a fire of wood charcoal, can possibly melt the mixture prescribed. The platinum I used, was some I bought of Dr. Bollman, procured by dissolving the crude platinum in nitro-muriatic-acid; precipitating by sal ammoniac in solution; stopping so soon as the brown precipitate of palladium appears; washing the nankin coloured precipitate *moderately* in water; drying it; heating it in a flat vessel, under a muffle, to drive off the nitro-muriatic-acid; collecting the gray coloured metallic powder; compressing it in an iron box with a powerful screw; alternately hammering it (gently at first) and annealing it, till it will bear extension under the hammer. My specimens are of specific gravity 20.8. In the following experiments I used this platinum, rolled thin and cut into small pieces.

I took of copper, by weight, 16 parts: platinum, 4 parts: metallic zinc or spelter, 3 parts. I melted the copper first, and then threw in the zinc and platinum folded up in paper, adding some rosin. The heat was then kept up for half an hour, and the alloy poured into an ingot-mould, greased. I had tried three experiments with different proportions of the materials, before I settled upon this.

The result was, an alloy, well fused, clean, even surface, compact, of a very passable gold-colour, and bearing an excellent polish. Other proportions of the metals employed may answer better, but this an-

swers (as I think) very well. If too yellow, add a little more copper: if too red, a little more zinc.

I am informed that although zinc will not unite chemically with copper in a greater proportion than 25 per cent., yet the brass makers by pouring the zinc into melted copper, make a brass, containing 35 per cent. of zinc. In my mixture the zinc is about $\frac{1}{5}$th part. If I were to suggest any alteration, it should be to increase the platinum to 5 parts instead of 4.

These experiments led me to believe that platinum would be a great improvement to *speculum metal.* I therefore made the following mixture, three several times, viz. Copper, 320 grs. Tin, 165 grs. Zinc, 20 grs. Arsenic, 10 grs. twice using the white arsenic, and once the metallic arsenic (the fly stone of the Philadelphia shops.) In all 515 grs. The results were, a bluish-white, silvery mixture, very dense and very brittle, bearing a fine polish, having a considerable increase of specific gravity: such as I remember to have procured formerly, on repeating Mr. Edwards' receipt for speculum metal. The above proportions are very nearly his, and Mr. Little's, as you will immediately recognize. The specific gravities were, 9.—9,116 and 9,8. I remelted them altogether, and the specific gravity of the mixture was exactly 9,1. The colour, the fracture, and general appearance, were manifestly improved by remelting.

I then took the same quantities and proportions as at first, adding to them 60 grains of platinum, making the whole weight 575 grains. It melted into a yellowish-white, very close grained alloy, bearing a far better polish than any of the specimens above mentioned. Specific gravity, 9,472. The platinum appeared to be a manifest improvement. The yellowish colour (which I did not expect) may be no disadvantage, as the yellow ray is much the most luminous. The acquisition of density in the specimens after Mr. Edwards' and Mr. Little's proportions, and the apparent defect of density in the specimen with platinum, I know not how to account for, except from the general fact that no alloy follows the arithmetical proportion of specific gravity.

Specific gravity of the copper used, - - -	8,487
Of the platinum, - - - - - - - -	20,8
Of the tin, (grain tin,) - - *not taken.*	
Of the zinc, - - - - - - - - -	7,078
Gold coloured alloy, - - - - - - - -	9,0487
Of the white coloured speculum metal, - - -	9,1
Of the speculum metal with platinum of a yellowish-white colour, - - - - - - - - -	9,472

The superior density of this last alloy, I suspect to be owing to the arsenic.

I am, Dear Sir, your friend and servant,

THOMAS COOPER, M. D.

P. S.—I hope some ingenious workman in metals will repeat these experiments.

Progress of Manufactures and the Arts in France.

Although the French have been long and justly celebrated, for the beauty, taste and excellence of many of their productions, they have remained very far behind the English in the manufacture of fabrics of cotton; in the extent and perfection of their iron works, as well as in a considerable number of other important branches of metallurgy, and other arts. Within a few years, however, they have made rapid strides towards perfection in these branches of industry; the pressure which has been so heavily felt by the manufacturers of Great Britain, has caused many thousands of them to remove to France, where they have taken the machinery and the knowledge, in which that country was deficient. The evident policy of the French nation, was liberally to encourage persons of this description, and they have not neglected their interest in this particular.

In a late number of the "Annales de l'Industrie," there is a notice of an extensive iron work established at Charenton, in the vicinity of Paris, by Messrs. Manby and Wilson. The writer of this notice observes, that these works exhibit the perfection which the art of working in iron has attained in England, and which is now naturalized at Charenton, where may be evidently seen, the immense superiority of large works, to those on a more limited scale, which are always indifferently provided with the means of working, and the productions of which are consequently restrained, both in their forms and dimensions, by the extent of the works; that under consideration, will supply whatever is required, without resorting to foreign countries; and with the rapidity, perfection and economy of the English manufactories.

At the establishment of Manby and Wilson, there are about 700 workmen employed, about 350 of whom are from England, and an equal number are natives of France.

Steam Engines of all dimensions, as well as all kinds of machinery required for carrying other manufactures to perfection, may be obtained at these works.

The notice contains many details of the mode of procedure, in casting, forging, turning, &c. in the large way, which although new in France, are extensively known in this country.

The following observations on the perfection of some other arts in France, are from a late English paper.

"Within these twelve years, France has made immense progress in almost every branch of manufacture. Pins are now made at a single operation, the 'heads and tails' being of a piece; so that the proverb, 'As useless as a pin without a head,' is likely to be soon lost, from the thing not being possible.

"A new discovery has been made in printing, by which classical works used in every country, need only to be set up once: thus, if an edition of the classics be printed at Paris, editions may be published in England, Germany, Holland, &c. without being at the expense of a new composition. Besides the advantages of cheapness, the text, once established, can never vary, and the type is *always*

new. We have seen three volumes in 8vo. printed upon the new principle; they are beautifully got up, and sold to the public at less than 3*s*. the volume."

"In the article of plated goods, the French seem even to surpass the manufacture of Birmingham. We have seen plated candlesticks, of which the making cost only five sous the pair, and they are sold at twenty pence in retail. The same manufacturer has discovered the method of making coffee-pots, tea-pots, &c. of one piece of metal, without soldering, and that too at a cheaper rate than by the old method: we have seen several articles of this kind, of very elegant forms."

"The gilding of metals is now carried to a perfection unknown in England; and as the duty on importation amounts to a prohibition, one of the best French gilders is going to establish himself in London. Our dessert services may thus rival the French in elegance and cheapness; and it is to be hoped that we shall soon be delivered from the heavy tribute paid to France for all objects in *or molu:* it is a branch of industry which would be most lucrative, and which it would cost a mere trifle to create: whoever does it, is certain to realise an immense fortune."

An easy method of dividing plates of hardened steel, such as saw plates; and also of perforating them, when requisite.

BY THE EDITOR.

Workmen frequently wish to divide a broken saw plate, for the purpose of converting it into scrapers, square-blades, or small saws; this is usually attempted by notching them to a small depth with a cold chisel, and then breaking them along the lines so made. When the plate is very hard, this method will not succeed, and the plate is frequently destroyed in the attempt. When it does succeed, the plate is generally twisted, and *buckled*, in the operation.

The Editor had a hard plate, which he was desirous of cutting into strips, to make small saws for a working model of a saw mill; this, although too hard to yield to the chisel, he divided with the utmost facility, piercing the ends at the same time, for the purpose of stretching the saws; this was effected in the following manner. The saw plate was made sufficiently warm to melt bees-wax, which was then rubbed over it, so as to coat it completely on both sides, when it was suffered to cool. Lines were then drawn through the wax on both sides of the plate, with a steel point. It being of great importance that these lines should be exactly opposite to each other, this was effected by making a saw-kerf in the strip of wood which was used as a straight-edge, and the plate being placed in the kerf, the opposite lines were easily drawn. A mixture of sulphuric acid (*oil of vitriol*) and water had been prepared, and suffered to become cold;

the proportions about one part of acid to six of water. The saw-plate was then placed in a common queens-ware dish, sufficiently large to contain it within the rim, and the acid and water were poured into it, so as just to cover the saw-plate; in about half an hour it was taken out, washed in clean water, and the wax scraped off, the lines having been bitten in to a sufficient depth to cause the plate to break with great ease. Some pieces which were left in too long, were eaten quite through, and the edges rendered rough and indented by the action of the acid.

At the ends of the plates, where holes were wanted, the wax was removed on each side; it was found necessary, sometimes, to insert these ends in the fluid, longer than the time allowed for the action on the lines; this, however, depends upon the thickness of the plate. Circular saws may be readily made in this way, and their centres perforated to any size. Square or round holes may be made through a plate of one-fourth of an inch in thickness without the slightest difficulty. To effect this, after covering the part with wax, and scratching through it, in the way directed, a wall, or bank, of wax is to be placed round it, so as to form a cup, into which the liquid may be poured; this operation must be repeated on the opposite side, and when the lines are bitten to a good depth, the piece may be punched out.

Whenever the plate to be divided, or perforated, is large, a bank of wax may be made to surround the parts, or the acid and water may be repeatedly washed over the lines, until the corrosion is sufficiently deep.

Care should be taken to employ good, clean wax; for the acid will find its way through it wherever there are any specks of dirt, and thus injure the face of the plate. Engravers' etching ground would be a better article than wax, but the latter is easily obtained, and, if pure and clean, will answer very well.

Saws and other tools of iron or steel, may be readily marked with the name of the owner of them, by the foregoing process.

A new mode of Paving proposed.

TO THE EDITOR OF THE FRANKLIN JOURNAL.

Sir—Some judicious remarks upon the subject of paving, have appeared in the recent numbers of the Franklin Journal, and as it is a thing of very considerable importance, I have determined to offer you my speculations upon it, which, should they not be esteemed of much value, shall not demand much space on your pages.

In large commercial cities, where many thousands of inhabitants are crowded together, and occupy but a small space of ground, the constant passing to and fro of vehicles of every description, from the heavily laden wagon, to the light pleasure carriage, soon disturbs the ordinary pavement, so as to interfere materially with the ease and

comfort of those who travel over it. It is scarcely to be expected, that a more permanent mode of paving can be devised, without a considerable increase in the cost of the operation; but if permanence can be attained, a much larger expenditure, at first, might in the end prove to be good economy. So well convinced of this fact were the inhabitants of London, that they, a few years since, undertook to pave a part of that city with cast iron; I am not fully informed of the result of this experiment, but have understood, that, although the iron was checkered in the casting, the surface was soon worn so smooth, as to render travelling upon it insecure.

The mode which I wish to propose, will certainly be expensive at first; so would the laying of iron pipes have been, when our water-works were first established, but we now *feel* that it would nevertheless have been good economy.—But, to come to the point—I would make a double pavement, in the following manner: I would dig sufficiently deep to place a good bed of gravel, upon which I would lay my sub-pavement, which might be of rough stones; these should be well rammed, so as to make a foundation of great solidity; upon this, a second bed of gravel is to be spread, and upon this I would lay a good pavement, in the usual manner, which should also be carefully consolidated; the operation is then finished.

The bed of gravel between the two strata of stones, must, in every part, be sufficiently thick to prevent their ever coming into contact with each other, or the upper stones would rock upon those beneath. A road made in this manner, would possess a degree of firmness which would resist the effects of weather, whilst the pressure upon the surface, would, through the intervention of the sub-pavement, be distributed over an increased portion of the earthy foundation. The sub-pavement would never need to be repaired; and although the upper pavement must in time wear out, and might be subjected to accidental disturbance, the repairing of it would become a very simple operation.

Yours, &c. VIATOR.

Description of Mason and Tyler's improved Face Chuck, for Turners.

TO THE EDITOR OF THE FRANKLIN JOURNAL.

Sir—Should you think the following description of a reverse face chuck worth communicating to the public, through the medium of your very useful publication, it is at your service.

The flat, or face chuck, is a well known, and useful appendage to the lathe; but having frequent occasion to chuck a piece, with its faced side outward, and finding all the usual methods too tedious and uncertain, we have contrived the chuck here described, which obviates every difficulty.

This chuck consists of a circular plate, like that of the common face chuck; it is perfectly flat on both sides, and of equal thickness through-

out, and is so formed, that when attached to the mandrill, a space of two or three inches is left between the back of it, and the mandrill, so as to allow the piece of work to be fixed on either side of the plate, with its faced side either to, or from, the workman, as occasion may require.

The plate should be no thicker than is necessary for stability; it has a hole through the centre, and through this hole the work is performed, when the piece has been properly secured by wedging, or otherwise.

Another method, and one which we prefer, is, to add to the common face chuck, at the distance of two or three inches from, and parallel to it, a second plate, faced on the inside, and having an opening in the centre, through which the work is performed.

This second plate is supported from the first, by pillars, or blocks of equal thickness, three or four being used, according to the size and shape of the piece to be chucked. Screw bolts pass through these several pillars or blocks, to secure the front plate in its place.

This chuck, with its pillars, or blocks, resembles the two plates of a circular time piece, with their pillars. In this chuck, any piece which is not thicker than the space between the two plates, may be fixed for drilling or turning, with the most perfect facility; the usual way of doing this, is by wooden wedges driven between the work and the back plate. Set screws are also used, when required by the nature of the work.

Very respectfully, yours, &c.

WM. MASON & R. TYLER.

Philadelphia, Feb. 20, 1827.

Patent Condensed Wood.

In page 348 of our first volume, we published an account of the patent taken out in England by Mr. Atlee, for condensing wood; and at the same time, expressed our doubts of the utility of the process. The subjoined letter from Mr. Atlee to the editor of the Register of Arts, together with the observations of that gentleman, seem to place the process in a favourable point of view, sufficiently so at all events, to show that the subject is worthy attention. The experiment may be readily made upon small pieces of mahogany, or other wood, with the rolling mill of the silversmiths. Should any of our mechanics try it, we should be glad to learn the result.—*Editor.*

"*To the Editor of the Register of Arts and Sciences.*

"SIR—Through the medium of your valuable and widely circulated columns, I am desirous of introducing to the consideration of the public, a description of the patent I have recently obtained, for the condensing of wood. In submitting my sentiments upon this subject, to the ordeal of scientific criticism, by which the merits of the invention will be either acknowledged or disproved, I have the satisfaction of declaring that my own opinions have not been hastily

formed, but that they proceed from long investigation, and have received the approving sanction of eminent and experienced engineers.

"The mechanical process of condensing timber is effected by passing a plank through a rolling press, by which operation every particle of mucilaginous juice is completely extracted. By thus destroying the porosity of the wood, and expelling the vegetable mucus, the interstices are effectually and permanently closed. It may thus fairly be presumed, that a plank of condensed timber, being purified from all those qualities which generate putrefaction, is secured and rendered proof against the destructive influence of the dry-rot. Chemistry teaches us, that the decomposition of matter, in other words putridity, is almost entirely occasioned by the action of air. In proportion as the atmosphere is heated, stagnant, and moist, fermentation proceeds, and it necessarily and obviously follows, that the decomposing power of the atmosphere, will be more essentially exerted on a porous substance, than on one whose component interstices are more closely rivetted together, and which altogether presents a harder, and more impervious resistance.

"It is precisely to effect this object, that my patent is calculated, by converting a juicy, porous, and spongy material, into a durable, firm, and solid substance. I am also convinced, from repeated experiments, that a plank of condensed timber will never shrink, or expand; which for building purposes, such as laying floors, pannels, &c. must be of the first importance; and I should recommend a coating of oil to be smeared over the plank, in some instances, before it passes through the rolling press, which will not only more effectually close up the interstices, but prepare the wood for receiving a higher polish, for various purposes: as, for instance, the painting of arms, or crests, on the pannels of carriages, and other descriptions of fine painting.

"In naval architecture, I flatter myself with the hope of being able to introduce a most valuable improvement in the articles of trenails. I propose to pass them through steel tube plates, to any required gauge, by which process they will be of one uniform dimension, and, in all probability, may supersede the use of copper bolts. Under the present system, it is utterly impossible to produce any regular equality in the size of trenails, but by the aid of my invention, every species of wood, in proportion to its natural texture, may be accurately and unerringly condensed, from ten to fifty per cent.

"Musical instrument-makers, particularly of piano-fortes, will derive a considerable advantage from the using of the condensed timber, which will not only remove the necessity of warehousing large quantities of wood, for the purposes of seasoning, but the tone of the instruments, especially in sounding boards, will be materially improved.

"I may also anticipate success in every article of furniture in which cabinet makers are concerned, book-cases, wardrobes, &c. for instance, constructed of condensed wood, will never shrink, nor can the doors ever swerve from their original positions. By this process a polish may also be given to mahogany which approximates it to the clearness of a mirror.

"All wood intended to be used in the operation of veneering will receive a manifest superiority by condensation, in as much as the material will become perfectly pliant. You may form some idea of the extraordinary power of the rollers, when I state to you, that a piece of veneering wood may be rendered so extremely flexible, as to admit of being tied in a knot. I could not without occupying too large a space in your Register, enter into the complete details of my patent, or particularize the various and remote ramifications to which it may extend.

"But from the preceding observations it may be perceived that I contemplate a decided improvement in the durability of all descriptions of timber, to whatever purposes applied. After several interviews with the navy board, I have received every assurance of support; and many of the most eminent musical instrument makers have encouraged me with the most flattering prospects of decided success. I have only to add, that the machinery, and steam engine, are nearly completed, and that in the course of a month or six weeks the merits of my patent will be submitted to the test of experiment on the large scale.

"I remain, Sir, your's, &c.

"James F. Atlee."

N. B. [We have seen some samples of wood, condensed by the above patent method, and were much surprised at their improvement in solidity, strength, and beauty. Some pieces of 7-8 inch plank of Honduras mahogany was reduced by the operation to 7-16, or to one half, and consequently its weight, or rather its specific gravity, was greatly increased; the texture of the grain was so much altered, as to resemble fine Spanish mahogany, to which, indeed, it must be vastly superior in durability and strength. Thinner pieces were reduced in a similar ratio, and were almost as elastic and supple as leather; and some samples of rose wood which had undergone the compression with their surfaces oiled, had acquired highly polished and smooth surfaces. The invention upon the whole promises the most valuable results, and claims the attention in particular of those classes of manufacturers, mentioned in the preceding letter.]

[*Ed. Reg. of Arts.*

Effectual means of preserving Wood.

TO THE EDITOR OF THE REGISTER OF ARTS.

Sir—Amidst the contrariety of opinions which distract the minds of the mechanic and philosopher as to the cause of the dry rot, and the means of remedying that destructive evil in wood, I do not remember to have seen any observation upon the effect produced by the submersion of timber in the fluid that is drained from iron pyrites, or (as it is usually termed) copperas stone liquor, previous to the chemical operation that is pursued to make the sulphate of

iron from that fluid. Being the other day at the Copperas Works in the vicinity of Whitstable, in the county of Kent, I was forcibly struck with the remarkably sound state of the whole of the timber which had been lying about the premises for years, and formed part of the buildings of those works; they were much discoloured, in consequence of being saturated with the copperas fluid, or from exposure to the influence of air impregnated with the steam from the standing works, or from the evaporation of the deposits, and pits of copperas stone and liquor.

Inquiring of the seafaring persons on the spot their opinion of the cause of the wood being thus secured from that destructive disease,—their unanimous opinion was, that dry rot never occurred when wood had been soaked in copperas fluid; and so deeply rooted is their conviction of the fact, as to amount to a proverb.

Inferring that some advantage might be derived by the knowledge of this circumstance to those who feel an interest in the preservation of wood from rot, I have taken the liberty of directing your attention to the subject. And, were experiments tried upon wood felled at different seasons of the year, and immersed in any of the copperas pits in the kingdom, it might set at rest speculative opinions on this matter, and conduce to important advantages to the country.

Some of the individuals with whom I entered into conversation on the subject, have made their observations on the preservative qualities of the copperas fluid on wood, between 60 and 70 years.

What injury might be done to iron nails, or copper bolts, driven into the wood thus saturated, I am incapable of forming a judgment; but much of the timber at the copperas works had bolts and large nails remaining fast, which appeared only rusty and deteriorated by exposure to common atmospheric changes.

I am, Sir,

Your most obedient servant,

J. B. C.

[That we entertain a most favourable opinion of the utility of the process recommended by our intelligent correspondent, our readers may be assured, when we acquaint them that it has, in part, formed one of our favourite schemes for some years past; but the pressure of other matters has prevented us from making the necessary experiments. Our intention was first to subject various kinds of wood to dry distillation by a slow process, and afterwards, by the aid of a Bramah's hydrostatic press, to force into and fully saturate the pores of the wood with salts of iron or other metals in solution. The expense of the operation would not be heavy, while there is scarcely a doubt of its entirely preventing the dry rot, and, at the same time, so far extending the durability of the timber, as, ultimately, to render the process one of great economy.]—*Editor of the Register of Arts.*

On a new kind of Cloth, fabricated by Insects.

Extract from the Memoir of Mr. Lenormand, read at the National Institute of France, on Monday, the 9th October, 1826.

Mr. Habenstreet, of Munich, has succeeded in procuring the cloth in question, by directing, after patient efforts, the labours of a kind of caterpillars, in a certain space. These caterpillars are, according to this ingenious gentleman, the larvæ of a butterfly, described under the name of *Finea punctata*, or *Finea padilla*, by some authors. Their instinct teaching them to construct over them a tent or covering, of extreme fineness, but nevertheless of sufficient texture, impervious to air, and which may be easily separated from the body, upon which it rests; Mr. Habenstreet took advantage of this circumstance, to make the insects work on a paper model, suspended from the ceiling, to which model he gave precisely the form and dimensions which suited him. He thus obtained square shawls, of an ell in size; some of two ells in length, by one in breadth; an air balloon, of four feet high, by two in horizontal diameter; a woman's complete robe, with the sleeves, but without seams. In order to give the tissue a regular form, it is often necessary to fix limits, beyond which the caterpillars must not go: to this end, one has only to touch the interdicted parts with oil; for the worms, having a natural antipathy to this substance, will never work on those spots which have been oiled; they will not, in short, touch them; so that Mr. Habenstreet succeeded in making the caterpillars fabricate a stuff, which appeared as if regularly stitched. It is easy to conceive that the number of caterpillars required for a given work, must be proportioned to its dimensions; one, or two at most, are sufficient to form a square inch of cloth; so that their number is not so great, as one, at the first view, would be inclined to imagine.

Mr. Lenormand enters into details upon the nature of the cloth produced by the caterpillars. This stuff, although of considerable firmness, yet is of a fineness which exceeds that of the lightest gauze. Mr. Lenormand exhibited to the Academy a specimen of the cloth; it would be difficult, without having seen it, to form an idea of its extreme levity.

Mr. Paret, professor of chemistry in the Academy of Stockholm, who sent the above mentioned specimen to the author of the memoir, saw himself, the insects at work; and furnishes, on this head, some curious details.

The balloon, mentioned above, weighed less than five grains; nevertheless, it was air tight; the heat of the hand was sufficient to inflate it in an instant; and the flame of a single match, held for some seconds beneath it, caused it to rise to a considerable height in the air, where it remained for half an hour.

A shawl, of an ell square, on being extended, was blown into the air, by a slight puff, and it then resembled a light vapour, gently agitated by the wind.

Mr. Habenstreet offered to make a present of a shawl to Mr. Paret, on condition that the latter would cause it to fall from the air upon his head; but this was found to be impossible; for as the shawl ap-

proached his body, the heat which exhaled from it, produced sufficient agitation in the air to repel the shawl.

As was before stated, Mr. Habenstreet caused the caterpillars to fabricate a complete robe, which he presented to her majesty, the Queen of Bavaria, who frequently wore it over her dress, on court-days.

It is easy to conceive that Mr. Habenstreet has been enabled to succeed in his undertaking, only after numerous experiments, prosecuted with indefatigable patience. The productions of the caterpillars are composed of the same materials as those of which they form their cocoons. This singular fabric has no resemblance to silken stuff, the filaments of which are regularly interlaced; whereas, those whereof the former is composed, are *superposed*; and this act takes place at the moment that the insect secretes the matter which forms the stuff. Mr. Habenstreet has been enabled to give to this novel manufacture, an increased solidity, by compelling the insects to labour several times over the same surface. This labour can neither be so long nor so difficult as may be conjectured, since Mr. Paret saw. at Munich, a shawl, of an ell square, which cost only the trifling sum of eight francs.

The caterpillar which effects the fusain (*euonymus europæus*,) and which, in France, is more common than that* made use of by Mr. Habenstreet, spins its threads, and forms a tent in a similar manner; and advantage may be taken of its labours, by following Mr. Habenstreet's process, which is indicated in the memoir of Mr. Lenormand; but to this end, says the latter, one must be possessed of industry and patience, equal to those qualities which are so conspicuous in the Munich entomologist.

On ornamenting steel with gold and platina. By NICHOLAS MILL, *Esq.*

Bridge Cottage, Camberwell, Jan. 8th, 1826.

SIR—In a paper inserted in your Repository for November last, I suggested some inquiries respecting the various methods of gilding practised by artisans. Since that period, I have been prosecuting some experiments, with success, for ascertaining the proper mode of superficial gilding upon steel: and I transmit the result to you, for the benefit of that class of artists. It is necessary, perhaps, to premise, that the instructions given, in most elementary works upon chemistry, for gilding with the ethereal solution of gold, are either erroneous, or not sufficiently explicit; and to this cause may be traced the many failures which have occurred in practising this art.

The following is the process which I used; and which answers equally well, either for gold or platina.

Dissolve any quantity of gold or platina in nitro-muriatic acid (*acqua regia*,) until no further effervescence is occasioned by the application of heat. Evaporate the solution of gold or platina, thus

* This cloth-weaving insect inhabits the European bird-cherry, *prunus padus*; but we suspect that there is some mistake in its generic name: we cannot find, in our books, the genus *Finea*. Perhaps it is the *Phalæna punctata*, of Gmelin, Tom. i. p. 2482.

formed, to dryness, in a gentle heat; (it will then be freed from all excess of acid, which is essential;) and re-dissolve the dry mass in as little water as possible: next take an instrument which is used by chemists for dropping liquids, known by the name of a separating-funnel, having a pear-shaped body, tapering to a fine point, and a neck capable of being stopped with the finger or a cork; which may contain a liquid ounce, or more: fill it with the liquid about one quarter part; and the other three parts, must be filled with the very best sulphuric ether. If this be rightly managed, the two liquids will not mix. Then place the tube in a horizontal position, and gently turn it round with the finger and thumb. The ether will very soon be impregnated with the platina or gold, which may be known by its change of colour. Replace it in a perpendicular position, and let it rest for twenty-four hours; having first stopped the upper orifice with a small cork. The liquid will then be divided into two parts; the darkest coloured being underneath. To separate them, take out the cork, and let the dark liquid flow out: when it has disappeared, stop the tube immediately with the cork; and what remains in the tube is fit for use, and may be called the gilding-liquid. Let it be put into a bottle, and tightly corked. When an article is to be gilded, a vessel of glass or unglazed ware must be provided, of just sufficient size to admit the article: it must then be filled with the gilding-liquid, nearly to the top. The steel must be *very highly polished*, and be entirely free from *rust* or *grease*. A basin, full of clean water, must be ready at hand: the article must be immersed into the gilding-liquid, and allowed to remain *as short a time as possible;* then be taken out, quickly plunged into the water, and well rinsed: it must next be dried with blotting-paper, and be placed in a temperature of 150° Fahr. till it be completely heated throughout; it may then be polished with rouge and a soft leather; or, which is better, be burnished.

It will be as well to observe, perhaps, that the muriate of gold or platina, formed by digesting these metals in nitro-muriatic acid, must be entirely free from all excess of acid; because it will otherwise act too forcibly on the steel, and cause the coating of gold to peel off. Pure gold must be employed. The ether must not be shaken with the muriate of gold, as is advised in chemical publications, for it will be sure, then, to contain acid: but, if the two liquids be continually brought into contact, by the motion I have described, the affinity between ether and gold is so strong, as to overcome the obstacle of gravity, and it will hold the gold in solution. The ethereal solution may also be concentrated by gentle evaporation. Care must be taken not to wipe the steel until the heat has been applied. This gilding is an effectual protection against rust; and is, at the same time, very ornamental.

I am, Sir, your obliged servant,

NICHOLAS MILL.

T. GILL, *Esq*.

[*Technical Repository*.

Method of Procuring good Yest.

Put four or five handfuls of hops in a linen bag, place it in a large pot, and pour on it boiling water, or make it boil for some time. Divide the decoction into equal parts. The first part is poured while hot into a kneading trough, in which is a little sour paste of dough. Add to it a little sugar, a few whites of eggs well beaten, and a sufficient quantity of wheat flour to form a paste of ordinary consistency; knead it well, and cover it over. When the mass is well risen it may be used for the purpose of fermenting the finest wheat paste or dough, without any fear that the bread, after baking, will retain the least sourness, because the acetic acid of the leaven has been completely decomposed in the course of the fermentation. It is probable that this would not have been the case without the sugar and the eggs. To obtain a leaven which will answer for future batches, reserve a portion of the dough, pour on it the second half of the decoction of hops, previously heated, and add the same quantity of sugar, white of eggs, and flour as before, knead the whole with a bit of the former leaven, and let it rise in the trough. Nothing but flour need afterwards be added. [*Bul. de Sciences, Sept.* 1825.

Iron-Wire Suspension Bridge at Geneva.

A second suspension bridge has been constructed at Geneva, of iron-wire, as successfully as the first. (See *Register of Arts*, vol. I. p. 133.) It extends in the same manner over the ditches of the fortifications; its length is 82 metres (269 feet,) that, however, being divided into two portions by an intermediate piece of masonry. Its width is two metres (6.56 feet.) It descends from the town side outwards, and also passes obliquely at an angle of 60° from the abutments, circumstances which raised the expenses to 30,000 francs. The suspension cables are four in number, and contain each 135 wires running the whole length; the wires are held at the extremities in a hollow cone, and the flexure of the cables is one-twelfth of the distance between the points of attachment. The bridge, when finished, was laden for trial, with stones, timber, &c. equal in weight, to that which would have been occasioned by covering it with people, which trial it bore without the slightest derangement.—*Biblio. Univer.*

Suspension Bridge over the Neva, at St. Petersburg.

It is in contemplation to erect a suspension bridge of iron across the Neva, at St. Petersburg; it having been found impossible to erect a bridge of stone or wood, on account of the great depth, and occasional rising of the waters. The depth above the ordinary level, is about 42 feet; and this is increased by inundations to 60 or more feet. The proposed bridge is, therefore, to consist of *a single arch of* 1022 *feet span.* It is to be composed of three distinct bridges, one on each side, 9 feet wide, for carts, &c. a middle one with a road, 21 feet wide, for carriages; and two path ways, each 5 feet wide, for pedestrians. The suspension chains are to contain in their section, a total surface of 400 square inches.

Metallic Healds or Heddles.

A PATENT has been recently granted to Mr. John Osbaldeston, of Blackburn, for an improved method of making the healds or heddles of weaving looms. The healds (as our readers generally well know,) are formed of two rods, one above and the other below the piece, and connected together by numerous strings, through which distinct portions of the warp pass, and by means of the treadles are lifted and depressed. Instead of the numerous cords, the patentee employs very thin slips of brass placed edgeways, which are bent in the middle, and a hole made obliquely in each, so that the threads of the warp may pass through them without being drawn out of a straight line. The top and bottom rails are of wood, with a metallic groove in each, in which slide pieces of metal adapted to receive the thin blades of metal, and to be connected together by rods pressing through them.

On the use of animal charcoal for purifying Pyroligneous Acid. By M. BERZELIUS.

ACCORDING to a statement made at the Royal Academy of Sciences at Stockholm, it appears, that by the use of animal charcoal, every particle of empyreumatic oil may be removed from pyroligneous acid.

M. Berzelius has discovered by some experiments, that the residue of the charcoal obtained in the fabrication of Prussian blue, at the time of the extraction of the *hydro-cyanate ferro of potash*, possesses this power to such a degree, that a very small quantity of it suffices to purify the pyroligneous acid, and to deprive it of all empyreumatic flavour. The whole process consists in mixing the acid with the charcoal, and afterwards straining it. Hartshorn purified by distillation and charcoal, is at first white, but becomes afterwards darker, because the empyreumatic oil contained in it is not absorbed, but only rectified; M. Berzelius, apprehensive that the same result might ensue with the pyroligneous acid prepared as before described, left some of it in a bottle badly stopped, for the space of five months, and at the end of that time, could not, after putting it to the most severe tests, discover any appearance or flavour of the empyreuma. [*Ib.*

Sinking of the Parisian Pantheon.

PERHAPS no more striking illustration can be given of the necessity of having the surfaces of joints rigorously parallel in every part of an edifice, that what occurred in building the Pantheon at Paris. In this edifice, a vast and lofty dome was to be supported by four groups of elegant columns. In order to give the columns the appearance of consisting only of a single stone, the drums or truncated conical pieces of which the shafts were formed, were hollowed out towards

the centre, so that the edges of every two pieces might unite closely all round, and not leave the least visible separation. The aspect of these columns, when first erected, was beautiful; they appeared a *chef-d'œuvre* of art; but when the immense weight of the arch was laid upon them, the edges of the drums which alone were in contact, not having sufficient surface to support the pressure, split and crumbled away, and the whole dome settled down till all the surfaces of each joining came into contact. The architect found it necessary to erect some large massy pillars in the centre of each group of columns which supported the dome, and the beauty of the structure disappeared. It would have been preserved, had the joinings of the drums been surfaces applied to each other in every point. Geometry supplies us with the means of doing this in the most simple, as well as the most complicated cases.—*Dupin's Geometry.*

Power of the Sun's Rays.

Mr. Mackintosh, a respectable and intelligent gentleman, who is contractor for the government works, carrying on at Stonehouse Point, near Plymouth, having descended in the diving bell with workmen, for the purpose of laying the foundation for a sea-wall, reports, that when the machine, which is provided with convex glasses in the upper part of the bell, was 25 feet under water, to his astonishment he perceived one of the workmen's caps smoking; on examining it, he found that the rays of the sun had converged through the glass, and burned a hole through the cap; also, that similar effects had, during hot weather, frequently occurred on their clothes, so that the workmen, now aware of the cause, place themselves out of the focal point.

Notice of Bull on Fuel, &c.

In the fifth number of our first volume, we published the experiments of Mr. Marcus Bull, on the subject of fuel, and on the apparatus used for its consumption, and have since announced the republication of that paper, with some additions, forming a neat little volume.

It does not appear that the labours of Mr. Bull have received, at home, that attention which they merit, both from the importance of the subject, and the talent and industry with which his enquiries have been pursued. The following observations upon Mr. Bull's experiments, are from the *Revue Encyclopédique.*

"This performance is particularly remarkable for its accordance with the results of experiments of a different character, made in Europe. Mr. Bull carefully describes those which he has pursued, and this is not the least instructive part of his book. He compares his inquiries with those of Lavoisier, Crawford, Dalton, and Rum-

ford, and estimates the degree of exactness which they may have attained. He next describes his apparatus and modes of weighing; his methods of calculation, and the principles upon which they are founded. He reviews every thing of importance that has been done on this subject in France, Great Britain, and his own country, and turns to advantage every thing that he collects. His experiments were prosecuted during a period of six months, and extended to forty-six kinds of wood; to coal from seven mines in America, to those of England, and particularly to some kinds of charcoal, and finally, to a mixture of coal, charcoal, and clay, which is used in America, as well as in some parts of Europe. The memoir of Mr. Bull is the most complete that has hitherto been published upon the subject of fuel, which is so important an article in domestic economy. It is to be wished that it may be translated into French, in order that its usefulness may be more extensively diffused.

FRANKLIN INSTITUTE.

Standing Committees, 1827.

Building Committeee.

S. V. Merrick
John O'Neil
James M'Alpin
Isaac B. Garrigues
Samuel J. Robbins

Finance.

Paul Beck, jr.
Thos. M'Alpin
A. G. Ralston
John Richardson
Thos. S. Hansell

Instruction.

R. M. Patterson
A G. Ralston
I. B. Garrigues
T. Fletcher
C. C. Biddle
Roberts Vaux
Daniel B. Smith
J. K. Mitchell
Henry Troth
R. Peters, jr.

Models.

Rufus Tyler
John Struthers
John O'Neil
I. H. Schreiner
Joseph Beale

Library.

T. P. Jones
S. V. Merrick
A. Ramage
H. Lewis
W. S. Warder

Minerals.

P. A. Brown
T. P. Jones
Abraham Miller
John Harrison
R. E. Griffith

Inventions.

R. M. Patterson
James Ronaldson
T. P. Jones
J. J. Rush
M. W. Baldwin

Premiums.
James Ronaldson
T. Fletcher
A. G. Ralston
Abraham Miller
S. J. Robbins

Managers of the Sinking Fund.
A. G. Ralston
S. V. Merrick
John Richardson

Curators.

Harvey Lewis
Wm. S. Warder

Auditors.

Abraham Miller
Isaac B. Garrigues

Queries.

Economical Machine for Carding and Spinning Wool.

Can you, Mr. Editor, give any information respecting an economical machine for carding wool? There are small machines, which answer very well for cotton, and which are extensively used by some of the southern planters; but I do not know of any applicable to wool; one which could be turned by hand, is much wanted, both in the southern and western states, and particularly in the latter. If any machine has been invented for spinning wool, which can be used in farm houses, and which will considerably abridge the labour of preparing the yarn for the loom, there are thousands who would gladly avail themselves of it, was it within their reach.

A Western Farmer.

Economical Grist Mill.—Repeated enquiries have been made after an economical grist mill. We described one in page 29, of our second volume, which we know has answered the purpose well, in the hands of the gentleman from whom we received the description. It is however believed by many persons, that one still better may be made; we recollect hearing one spoken of in very favourable terms, which was patented by some gentleman in the state of Maine, but respecting its real merits, we are not fully informed. Such a mill is much wanted; it should not require more than the power of one horse; but a hand mill, would, in many situations be preferred. We have resided in the southern states, and know, from experience, that a mill which would make good corn-meal, which could be easily fixed, and not subject to be put out of order, is more needed there, and also in several of the western states, than any other machine for domestic use. We have ourselves sent corn thirty miles to a mill, and have waited four days for a turn; and similar circumstances are of general occurrence, during the dry season in July and August. Many fertile districts, are scarcely habitable, on account of their remoteness from good

streams; a difficulty which can be obviated, only by mills set in motion by some other power; and where the population is scattered, this power must be obtained at little cost.

LIST OF PATENTS IN ENGLAND,

Which passed the Great Seal in November, 1826.

To Benjamin Newmarch, of Cheltenham, Esq. for his invented improvements on fire-arms—Sealed 7th November.

To Edward Thomason, of Birmingham, in the County of Warwick, goldsmith and silversmith, for his having found out and invented improvements in the construction of medals, tokens, and coins—9th November.

To Henry Charles Lacy, of Manchester, in the County Palatine of Lancaster, coach-master, for his new invented apparatus, on which to suspend carriage bodies—18th November.

To Bennett Woodcroft, of Manchester, in the County of Lancaster, silk manufacturer, for his having invented or found out, certain improvements in wheels and paddles, for propelling boats and vessels—18th November.

NOTICES.

The article in our last number on the subject of Mill-spindles and Brands, ought to have had the signature of *William Poole*, instead of that of J. Morton Poole.

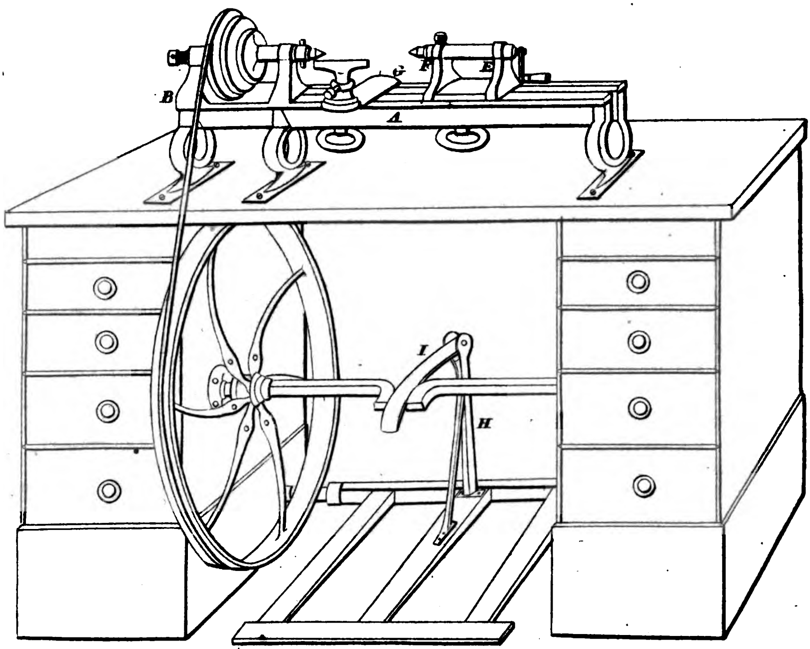
Those subscribers whose numbers were originally forwarded from New-York, will still direct their enquiries to the agent there, as their numbers are still put up in that city, and the agent here has not the means of correcting any mistakes.

A subscriber in the vicinity of Albany, wishes to have his numbers uncut. They are generally preferred cut, and the margin is widened by the printer with that view. We would with pleasure comply with the wishes of individuals, but the preparation for transmission is, of course, the work of agents, and perpetual mistakes would arise from the departure from a general rule. Should the number in question have been cut shorter than usual, on its return, another shall be forwarded.

Subscribers who pay the amount of their subscription, before the delivery of the number for April, will be considered as making payment in advance, in which case a deduction of 50 cents is made.

TURNING LATHE.

p 334



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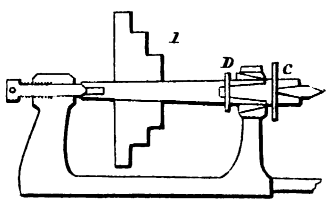

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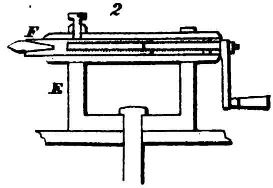

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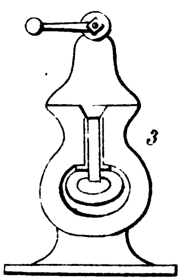

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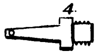

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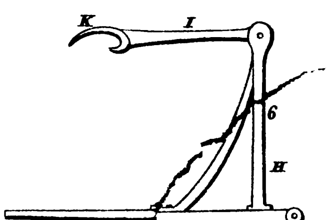

Drawn by J. Drayton.

THE

FRANKLIN JOURNAL,

AND

AMERICAN MECHANICS' MAGAZINE;

DEVOTED TO THE USEFUL ARTS, INTERNAL IMPROVEMENTS, AND GENERAL SCIENCE.

APRIL, 1827.

ON THE NATURE AND PROPERTIES OF TIMBER.

Extracted from "The Elementary principles of Carpentry," by Thomas Tredgold.

[Continued from Vol. II, page 149.]

Of the Prevention of the Ravages of Worms and Insects.

Besides the decay of its parts, timber is subject to be destroyed by various worms and insects. Some woods are more subject to be destroyed by them than others; such as alder, beech, birch, and, in general, all soft woods, of which the juices are of a saccharine nature.

Against the common worm, oil of spike is said to be an excellent remedy, and the oil of juniper, or of turpentine, will prevent them in some degree. A free use of linseed oil is a good preventive; but these can be applied to small articles only.

Evelyn recommends sulphur which has been immersed in aquafortis (nitric acid) and distilled to dryness, which being exposed to the air dissolves into an oil. The parts to be secured from the worm are to be anointed with this oil, which does not give an unpleasant odour to the wood.

Lime is an excellent preservative against the worm, and sap-wood should always be impregnated with it when used in a dry situation.

As worms do not attack bitter woods, soaking wood in an infusion of quassia has been tried, which is said to have the desired effect.

The bottoms of ships, and timbers exposed to the action of the sea, are often destroyed by the pipe-worm or *teredo navalis* of naturalists. This creature is very small when first excluded from the egg, but soon acquires a considerable size, being often three or four inches in

length, and sometimes increases to a foot in length. Its head is provided with a hard calcareous substance, which performs the office of an auger, and enables it to penetrate the hardest wood. When a piece of wood, constantly under water, is occupied by these worms, there is no sign of damage to be seen on the surface, nor are the worms visible till the outer part of the wood be broken or cut away; yet they lie so near the surface as to have an easy communication with the water by a multitude of minute perforations. They were originally brought from India to Europe.

Wood is eaten by them till it becomes like a honeycomb, yet there is an evident care in these creatures never to injure one another's habitations, for the divisions between the worm holes are entire, though often extremely thin. The fir and alder are the two kinds of wood they seem to destroy with the greatest ease, and in these they grow to the greatest size. In oak they make slower progress, and appear smaller, and not so well nourished.

They never touch bitter woods, and in solid or hard woods they make slow progress. Charring the surface of wood is not found to be of any use.

A mixture of lime, sulphur, and colocynth, with pitch, is found to be a protection to boards and the like. And rubbing the wood with poisonous ointments is a means of destroying them.

Coal tar is also a good protection against their depredations. The pores of the wood should be saturated as far as possible with it; and perhaps corrosive sublimate might be used with advantage, by saturating the wood with a solution of it, and letting it dry before the tar be laid on.

Whale oil is stated to be an effectual remedy, and has been successfully employed.

There is another kind of worm which is very destructive to timber, which Mr. Smeaton observed in Bridlington piers. The wood of these piers, he says, is destroyed by a certain species of worm, differing from the common worm whereby ships are destroyed. "This worm appears as a small white soft substance, much like a maggot; so small as not to be seen distinctly without a magnifying glass, and even then a distinction of its parts is not easily made out. It does not attempt to make its way through the wood longitudinally, or along the grain, as is the case with the common ship worm, but directly, or rather a little obliquely inward. They do not appear to make their way by means of any hard tools or instruments, but rather by some species of dissolvent liquor, furnished by the juices of the animal itself. The rate of progression," he was informed, "is, that a three-inch oak plank will be destroyed in eight years by action from the outside only." Fir is more subject to be destroyed by this worm than oak.

To prevent the destructive effects of these worms, Mr. Smeaton recommended that the timbers of the piers should be squared, and made to fit as close together as possible; to fill all the openings left with tar and oakum, and level the face and cover it with sheathing, as ships are covered.

These worms do not live except where they have the action of the water almost every tide; nor do they live in the parts covered with sand.

The remedies that resist the ship worm would no doubt be effectual against these.

The termite or white ant (a species of the genus *termes*, and of the aptera order of insects in the Linnæan system) is represented by Linnæus as the greatest calamity of both Indies, because of the havoc they make in all buildings of wood, in utensils, and in furniture; nothing but metal or stone can escape their destructive jaws. They frequently construct nests within the roofs and other parts of houses, which they destroy if not speedily extirpated. The larger species enter under the foundations of houses, making their way through the floors, and up the posts of buildings, destroying all before them. And so little is seen of their operations, that a well-painted building is sometimes found to be a mere shell.

Corrosive sublimate is highly poisonous to these ants; therefore, to impregnate the timber with a solution of it would prevent their ravages. Arsenic is also very destructive to them; and they do not destroy wood impregnated with oil, particularly essential oils. Thunberg found cajeput oil effectual in destroying the red ants of Batavia; he used it to preserve his boxes of specimens from them. When ants were put into a box anointed with this oil they died in a few minutes.

Of the Durability of Timber.

The carpenter who feels any delight in the progress of his art cannot be insensible to the advantage of giving durability to his materials; nor yet be uninterested in any inquiry into the probable extent of their duration. Not that his fame as an artist rests solely on the extent of their duration; for while his productions are worthy of imitation, the remembrance of them will be preserved by the engraver's art as long as there shall be men capable of paying a just tribute to the memory of departed merit. The French army, in 1799, destroyed the celebrated bridge across the Rhine at Schaffhausen; but the fame of Grubenmann the carpenter will long continue; and the form of that excellent specimen of the art will only cease to be remembered when carpentry itself no longer exists.

It must also be remembered, that to give durability to his materials is one branch of the carpenter's art; and that to be defective in this particular is as much to his discredit, as to be unacquainted with the geometrical or mechanical principles of carpentry.

As examples of the duration of timber, I have collected the following notices; and must, though not without regret, leave the subject to be extended by those who have better means of rendering it more complete.

Of the durability of timber in a wet state, the piles of the bridge built by the Emperor Trajan across the Danube is an example. One of these piles was taken up, and found to be petrified to the depth of three-fourths of an inch; but the rest of the wood was little different

from its ordinary state, though it had been driven more than sixteen centuries.

The piles under the piers of London Bridge have been driven above 600 years, and from Mr. Dance's observations, in 1746, it does not appear that they were materially decayed; indeed they are now (1819) sufficiently sound to support the massy superstructure. They are chiefly of elm.

We have also some remarkable instances of the durability of timber when buried in the ground. Several ancient canoes have been found in cutting drains through the fens in Lincolnshire, which must have lain there for many ages. In the Journal of Science, &c. published at the Royal Institution, one of these canoes is described, which was found at the depth of eight feet below the surface of the ground. It was 30 feet 8 inches long, and 3 feet wide in the widest part, and appears to have been hollowed out of an oak tree of remarkably fine free-grained timber.

Also, in digging away the foundation of old Savoy Palace, London, which was built 650 years ago, the whole of the piles, consisting of oak, elm, beech, and chesnut, were found in a state of perfect soundness; as also was the planking which covered the pile-heads. Some of the beech, however, after being exposed to the air a few weeks, though under cover, had a coating of fungus spread over its surface.

On opening one of the tombs at Thebes, M. Belzoni discovered two statues of wood, a little larger than life, and in good preservation; the only decayed parts being the sockets to receive the eyes. The wood of these statues is most probably the oldest in existence that bears the traces of human labour.

A continued range or curb of timber was discovered in pulling down a part of the Keep of Tunbridge Castle, in Kent, which was built about 700 years ago. This curb had been built into the middle of the thickness of the wall, and was no doubt intended to prevent the settlements likely to happen in such heavy piles of building; and therefore is an interesting fact in the history of constructive architecture, as well as an instance of the durability of timber.

In digging for the foundations of the present house at Ditton Park, near Windsor, the timbers of a drawbridge were discovered about ten feet below the surface of the ground; these timbers were sound, but had become black. Hakewell says, that Sir John de Molines obtained liberty to fortify the Manor-house of Ditton, in 1396; and it is most probable the drawbridge was erected soon after that time; and accordingly the timber had been there about 400 years.

The durability of the framed timbers of buildings is also very considerable. The trusses of the old part of the roof of the Basilica of St. Paul at Rome, were framed in 816, and were sound and good in 1814, a space of nearly a thousand years. These trusses are of fir.

The timber-work of the external domes of the church of St. Mark, at Venice, is more than 800 years old, and is still in a good state.

The inner roof of the Chapel of St. Nicholas, King's Lynn, Norfolk, is of oak, and was constructed about 450 years ago.

Daviller states, as an instance of the durability of fir, that the large dormitory of the Jacobins' Convent, at Paris, had been executed in fir, and lasted 400 years.

The timber roof of Crosby Hall, in London, was executed about 360 years ago; and the roof of Westminster Hall, which is supposed to be of chesnut, is now above 300 years old.

The rich carvings, in oak, which ornamented the ceiling of the king's room in Stirling Castle, are many of them still in good preservation. It is nearly 300 years since they were executed, and they remained in their original situation till a part of the roof gave way, in 1777, when the whole was removed, and has since been dispersed among the collectors of curious relics of old times.

Moreton Hall, in Cheshire, where "the staircase winds round the trunk of an immense oak tree," and the building itself is chiefly constructed of wood, has now existed 250 years.

And Mr. Britton describes an old house at Islington, constructed chiefly of wood, which he has ascertained to be about 200 years old.

Other notices of extraordinary durability will be found in the descriptions of the different kinds of wood. But enough already has been collected to show that timber is very durable where nothing more than ordinary means have been used to render it so; that is, nothing more than judicious selection and good seasoning.

Every permanent support should be a good and sound piece of timber; inferior kinds should be used for temporary purposes, and where no strain occurs, and consequently where they can be easily renewed without injury to the strength of the building.

Mr. Barrow, in writing on this subject, very judiciously remarks, "that the felling of timber while young and full of vigour, making use of the sap-wood, and applying it to ships and buildings in an unseasoned state, have no doubt contributed to make the disease of dry rot infinitely more common and extensive than it was in former times, when our ships were 'hearts of oak,' and when, in our large mansions, the wind was suffered to blow freely through them, and a current of air to circulate through the wide space left between the pannelled wainscot and the wall. In those old mansions which yet remain, and in the ancient cathedrals and churches, we find nothing like dry rot, though perhaps

> .... 'perforated sore
> And drilled in holes, the solid oak is found
> By worms voracious eaten through and through.' "

In regard to the durability of different woods, the most odoriferous kinds are generally esteemed the most durable; also woods of a close and compact texture are generally more durable than those that are open and porous; but there are exceptions, as the wood of the evergreen oak is more compact than that of the common oak, but not near so durable.

In the same kind of wood there is much difference in the durability; and the observation is as old as Pliny, "that the timber of those trees which grow in moist and shady places is not so good as that

which comes from a more exposed situation, nor is it so close, substantial, and durable;" and Vitruvius has made similar observations.

Also split timber is more durable than sawn timber, for in splitting, the fissure follows the grain, and leaves it whole, whereas the saw divides the fibres, and moisture finds more ready access to the internal parts of the wood. Split timber is also stronger than sawn timber, because the fibres being continuous, they resist by means of their longitudinal strength; but when divided by the saw, the resistance often depends upon the lateral cohesion of the fibres, which is in some woods only one-twentieth of the direct cohesion of the same fibres. For the same reason whole trees are stronger than specimens, unless the specimens be selected of a straight grain, but the difference in large scantlings is so small as not to be deserving of notice in practice.

[To be continued.]

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*On the preparation of Gold Beater's Skin, Lathe-Bands, Catgut, Strings for Harps, Violins and other Musical Instruments, &c.**

These various arts all require the previous freeing of the *muscular tunic* from the other membranes which constitute the gut. Anatomists distinguish in it, three membranes; viz. the external one, termed the *peritoneal;* the middle one, or *muscular* membrane; and the internal, or *mucous* membrane. Formerly, the guts were subjected to the putrid fermentation, in order to separate the peritoneal and mucous membranes from the muscular one; and this process was accompanied with such a fœtid effluvia, that the authorities obliged the manufacturers to establish their works at a distance from all other habitations. In 1820, the Prefect of Police, of Paris, proposed to the *Société d'Encouragement*, to offer a prize for a process, either chemical or mechanical, of effecting this object without submitting the guts to the putrid fermentation. The writer had the happiness to fulfil this object, and to merit the premium offered.

After the guts have been freed from all greasiness, by the usual methods, and turned inside-out, they are to be put into a tub, capable of containing as many as are produced from 50 oxen; and two buckets of water, each containing a pound and a half of the *eau-de-Jevelle*† (marking from 12 to 13 degrees of the *Pèse-liqueur*, or areometer for alkaline solutions), are to be poured upon them. If they should not be sufficiently wetted, throw over them another bucket-full of well or river water; they are then to be well stirred up, and left to steep all night. At the end of this time, the mucous membrane may be removed with as much facility as it could be after many days of putrid fermentation. At the moment of contact with the *eau-de-Javelle*, all fetidity totally disappears.

* From the *Dictionnaire Technologique*.

† This article is an alkaline liquid, manufactured in the vicinity of Paris, and sold at a cheap rate, for the use of laundresses, &c. Of this liquid we will give a further account, at the close of this paper.

The other operations may be afterwards performed in the usual manner.

On the preparation of Gold Beater's Skin.

When the workman has stripped off that part of the peritoneal membrane which surrounds the *cæcum*, he takes from 2 to 2½ feet in length of it, and inverts it, or turns it inside-out; he then leaves it to dry: when dry, it resembles a pack-thread. In this state it is sold to the manufacturer of gold-beater's skin; who takes the dried membranes, and soaks them in a very weak solution of potash. When sufficiently soaked, so as to have become gelatinous, he places them on a wooden plank, to scrape them clean, and cut them open with a knife. When the pellicles are well cleansed, and sufficiently freed from the water, they are extended on wooden frames, three or four feet long, and about ten inches wide; these are formed of two uprights, joined by two cross-pieces; the cross-pieces have grooves of three or four lines wide made in them.

In order to extend the membrane, the workman takes it in his hands, and affixes one end of it, by its glutinous quality, to the top of the frame, taking care that that part of the intestine which formed the outside of it be placed next to the frame; he then extends it every way, and causes it to adhere to the other end of the frame: this effected, he takes another membrane, and applies it upon that which is already extended, taking care that the muscular membranes should be in contact with each other: in this way, they become so perfectly glued together, as to form one solid body.

The two membranes soon become dry, except at their extremities, which are glued to the cross-bars of the frame. When the whole is well dried, the workman cuts the pellicles across at each end with a good knife, and separates them from the frame. The dried and stretched membranes are then delivered to another workman, to give them what is term *le fond*, being the last preparation; and to cut them into convenient sizes.

In order to finish the pellicles, the workman takes each band separately, and glues it on a similar frame to that which we have before described, but without a groove: he applies the glue upon the edges of the frame, and places on it the band of pellicle. When quite dry, it is washed over with a solution of one ounce of alum, dissolved in two wine-quarts of water, and again allowed to dry; it is then coated, by means of a sponge, with a concentrated solution of isinglass in white wine, in which acrid and aromatic substances have been steeped, such as cloves, musk, ginger, camphor, &c.: these last substances are added, to prevent insects from attacking the pellicle. When sufficiently coated with this composition, or, as the workmen call it, *grounded*, they, lastly, cover it with a layer of whites of eggs. The pellicle is then cut into pieces of about five inches square; submitted to the action of a press, to flatten them; and then formed into small packets or books for sale to the gold-beaters. This last process very much resembles that used in preparing the English Court-Plaster, or *le taffetas d'Angleterre.*

On the preparation of Lathe-Bands.

Before we make known the preparation of the intestines of sheep, for the manufacture of various kinds of cords, we shall mention that of those made of the horse, mule, or ass, called *Lorrains*, for lathe-bands. These intestines receive exactly the same preparatory treatment as those of the ox.

Grinders, polishers, and various other mechanics, use bands or cords, manufactured from the intestines of the horse, &c. freed from the mucous membrane. The gut is taken hold of by one end; into which is thrust a wooden ball, fastened on the end of a stake, fixed in a block; below this ball are four cutting-blades; or, to render the explanation more clear, it is a cutter formed of four blades and surmounted by a wooden ball: they draw down the intestine equally over these blades, with both hands, so as to cut it into four equal strips. They take four, six, or eight of these strips, accordingly as they wish the cord to be thicker or thinner; then tie these strips by a particular kind of knot at one end, with large twine, made on purpose, which they call a lace; and pass the end of it over a peg secured in a hole made in a post strongly fixed: at the distance of about 30 feet, is placed another post with pegs, on one of which they pass these strips: near to the first post, the strips are all tied together with a new lace, which they fasten to the peg whereof we have just spoken; the workmen call this first operation the "warping." They cut these strips, and fasten them as above described, if they are long enough (which is generally the case), being careful that the ends are always taken in with the thread, having cut them previously across, so that the seam shall not form any unequal thickness. If they are long enough, they make a second length, till the gut is all taken in, or the pegs entirely filled.

When the weft is finished, the workman places his wheel conveniently, and passes over the hook of the spindle the thread which holds the weft-cord: he puts on a second lace, if the wheel be strong enough to bear it; gives several turns to the wheel by means of a handle; and places the already-twisted cord over a hook. He acts the same with every woven cord; passing his hand carefully along the cord from the wheel, and cutting with his knife all those fibres or threads which will not form one body with the cord. This never shortens in drying, provided it is always gathered together at the same dimension over the pegs. Some hours having elapsed, they replace the cords upon the wheel, and twist them afresh: 12 or 15 hours afterwards they take them one after the other, and fasten the lace to a peg which they turn with the hand; the wheel seldom being strong enough. This twisting being effected, they rub it with a horse-hair cord dipped in water, which they form into a bundle, and hold between their hands. This operation is called "stretching." Another twisting is made 3 hours afterwards; and they stretch it as forcibly as possible, after again fixing the cords over the pegs, and to the posts.

If the cord, when sufficiently dry and twisted, is not exactly even, they polish it with a piece of dog-fish-skin; but if the horse-hair cord

has been passed enough over it, that becomes unnecessary. When the cord is dried and stretched, it is not generally sulphured. When perfectly dry, they cut the two ends near to the lace, and coil it into a ring for sale.

The instant that the workman who makes these cords receives the intestines, he is obliged to wash them, to turn them inside-out, and to steep them in a barrel, containing two pails of water, mixed with a pound of *eau-de-Javelle*, of the strength we have before noticed.—This quantity will serve for 15 or 20 intestines, and only increases the expense to the manufacturer, for this number, about ten centimes. On the morrow, he separates the mucous membrane, by the ordinary means; washes the guts in a large tub of water, cuts them into strips, puts the laces round them during the day, and gives them the first twist: the next day he finishes them.

If the cords are sufficiently dry by the next day, he is obliged, for the sake of salubrity, to repeat the operations. After this, the fœtid odour is no longer perceptible, and he may finish the cords at leisure.

On the improved distillation of Aromatic Plants, and particularly of Orange Flowers, by M. CADET-DE-VAUX, *and the late* WILLIAM LEWIS, M. D.

ALTHOUGH the progress of chemical knowledge is constantly destroying so many vulgar errors, still there are objects to be brought to perfection, which are interesting both to science and medicine.

Chemistry has recently extracted the vegetable substances *quinquina* and *ipecacuanha*, both strong poisons; but has neglected the improvement of many products in pharmacy, such as the distillation of the aromatic plants; and particularly of orange-flower water, which is still esteemed and retained amongst the empiric remedies.

If the distiller be asked how this water is to be drawn, he will reply, by putting the flowers into the still with a pailful of water, and submitting them, for a longer or shorter time, to a boiling heat; that the first product constitutes the double orange-flower water; and that the second product is a water which is quickly spoiled by keeping.

The following is the process, that, taught by science and experience, I have substituted for the faulty process prescribed in all the formularies. The superior quality of the product, as well as the simplicity of the process, it must be admitted, gives it a decided superiority. This is acknowledged by M. Vauquelin Nasaurion, Apothecary, rue Poissonnière. It consists merely in suspending in the body of the still, in the steam of the boiling water, a piece of flat wicker-work, or a metallic cloth, covered with the orange-flowers in a pyramidal form. This description does not require any further explanation. We may easily perceive, that the distillation need only be suspended, in order to empty the still of its refuse; and to put in fresh flowers and boil-

ing water, which may again be removed in about a quarter of an hour.

I have just compared the orange-flower water of this year with that of the two preceding years; and cannot perceive any difference between them. Such, then, is this very simple practice; and it is truly surprising that such a number of years, even of ages, should have passed without attaining the same end, with a simplicity which is indeed perfection. A. A. CADET-DE-VAUX.

Remarks by the Editor of the Technical Repository.—M. Cadet-de-Vaux is not so original in his discovery as he seems to imagine. In that excellent work, "*Newmann's Chemistry,*" translated by the late scientific Dr. William Lewis, we find the following note by Dr. Lewis, "*On distillation in the water-bath.*" It has been commonly supposed that a heat much less than that of a water-bath is sufficient to elevate the fragrant part of vegetables; that all those plants which diffuse their active effluvia through the open air, will give out the same effluvia when inclosed in close vessels, and exposed to a heat no greater than that of the atmosphere in summer.

"Take (says the celebrated *Boerhaave*) rosemary, fresh gathered, in its perfection, with the morning-dew upon it, and lay it lightly and unbruised within our little cylindrical furnace. Then cover the furnace with its large conical still-head, and apply a glass-receiver to the nose thereof. In the fire-place of the furnace put a lighted coal (i. e. charcoal) that does not smoke, and raise up an equal degree of heat, not exceeding eighty-five degrees on Fahrenheit's thermometer; and let this heat be kept up so long as any liquor comes over. This water contains the elementary water or presiding spirit of the plant; a spirit small in bulk, but rich in virtue, and exhibiting the specific smell, and taste, and particular virtue of the subject; leaving the remainder exhausted. Hence we may understand, that the various, peculiar, and often surprising virtues of plants may be widely diffused through the air, &c."

I have submitted to this process, rosemary and other aromatic herbs, without the promised success: the distilled liquors in general had hardly any thing of the fine flavours of the subject: even when the heat of boiling water was made use of, there were few plants that gave over to the distilled liquor any considerable smell or taste. It is by the assistance of free ventilation in the open air, that the sun's heat robs odoriferous plants of their fragrance; and even when thus assisted, it leaves their other active virtues unhurt: these, also, the humid air of the mornings and evenings dissolves and imbibes.

Hence the different effects, upon animal bodies, of the natural effluvia of the aërial infusions of certain vegetables, from those of their distilled waters. Damask-roses, in drying, impregnate the air of the room with their laxative virtue; and red-rose buds, in like manner, give out their astringency; virtues which never arise in distillation, but which common water and spirit extract readily by infusion. The author above quoted mentions some examples of this kind, without seeming to have duly attended to their consequences: for if the shade

of the walnut-tree make the body costive, and the effluvia of poppies procure sleep, as these virtues are incapable of being elevated in distillation, does it not follow that they must be communicated to the air upon some other principle?

With regard to the use of a water-bath, though there are few vegetables that give over their flavour in that degree of heat, yet, for those that do, it is undoubtedly of great advantage: fire sensibly injures, in proportion to its degree, the flavour of aromatic herbs; and those which are most volatile suffer the most from it. Some tender flowers, as those of rosemary, have their fragrance impaired by the bare mechanic action of watery or spirituous liquors, independently of heat, nearly as much as by bruising them.

In distilling these kinds of subjects, I have varied the process, by applying, instead of water or spirit in their gross form, only their vapours: the liquor being poured into a still, a hair-cloth, stretched on an iron hoop, is let in above it, and on this the fresh unbruised flowers are lightly spread: the vapour, into which the liquor is resolved by the heat of a water-bath, passing gently through the flowers, imbibes their fragrance unimpaired, and condenses into a water or spirit greatly superior to those prepared in the common manner.

The foregoing observations point out a method of improving also the preparation of extracts. If infusions of mint, balm, and sundry other vegetables of the aromatic kind, be distilled by a gentle warmth in close vessels, little more than the watery menstruum will arise, the greatest part of the flavour of the subject remaining behind in the extract. When the distillation is performed by a boiling heat, the whole of the flavour comes over with the water; and when the inspissation is performed in open vessels, however gently, it is almost wholly absorbed and carried off by the air. Our author himself (Newmann) seems to have been sensible of this, in his experiments on tea; for, in order to procure an extract from tea, possessing the admired flavour of the leaf, he finds it particularly necessary to inspissate the infusion, without communication with the open air.

Thus we see, that by distilling many odoriferous vegetables in close vessels, we may either obtain their fragrance in the water that distils, or retain it, in great measure, in the extract, according as the degree of heat made use of, is strong, or gentle;—and that by evaporating them in open vessels, their fragrance is carried off by the air.

On making *Distilled Waters stronger by Cohobation.*—This is another of the many processes, in which I have, on trial, been greatly disappointed. Though some of the chemists affirm, that distilled waters in general may be rendered, by repeated cohobations, of any assignable degree of strength, and their virtues exalted without limitation, I have not found that the repetitions of these operations make any considerable addition to the strength even of those waters whose exaltation has been specifically specified.

The distilled waters of mint, rosemary, and other aromatic herbs, being re-distilled a number of times successively, from fresh parcels of the respective subjects; instead of being more and more exalted and improved, they were, on every repetition, more and more debased. Some of them indeed, by one cohobation, seemed to be rather

mended, and sometimes a second did hardly any injury; but after this period, they all received an ungrateful taint from the repeated action of the fire, without gaining any more of the flavour of the subject than they had at first.

It is not by distillation, but by infusion, that water can be unlimitedly impregnated with any of the principles of plants. Water extracts, by infusion, the gummy parts of vegetables; and it is a property of all gummy substances to dissolve indefinitely in water; that is, to unite with any proportion of it, small or large, and render the liquor thicker and thicker, as the quantity of gummy matter is increased. When resins or essential oils are intimately combined with gums, as they are in most vegetables, these compounds also unite indefinitely with water.

Hence, by macerating or infusing, in the same water, fresh parcels of aromatic herbs, the liquor takes up more and more of the soluble parts, till it grows too thick to be poured off, and the loss of fluidity is the only limit to impregnation.

In distillation, on the other hand, nothing arises with the water, but the essential oil; and from the pure essential oils this fluid extracts only a limited quantity. Salts are, in this respect, somewhat analogous to oils: when a certain quantity of salt is dissolved in water, the liquor, though thin and fluid as at first, will take up no more. By the application of heat, it may be made to dissolve a larger quantity than in the cold; but all that is so dissolved will be separated and thrown out again, upon an abatement of the heat. Thus, when essential oils are coagitated with water by a boiling heat, and elevated along with it in the form of vapour, the water condensing again, keeps a part of the oil dissolved, and throws out the rest. The water is now saturated; and it is in vain to endeavour, by any repetitions of the distillation, to make it imbibe more.

Hence the use of employing the water that arises in the distillation of essential oils for subsequent distillation of the oil of the same subject: being saturated with oil in the first distillation, it dissolves none of that which arises with it in the others; and thus the produce of oil proves proportionably larger than if fresh water was taken.

It follows from this account, that there is one case in which cohobation may be of some service; that when the water is not fully saturated in the first distillation, it may be made to imbibe more, by a repetition of it. But surely it is more adviseable to use the plant in such quantity as may give a sufficient impregnation at once, than to endanger debasing the flavour which the liquor has once received, by communicating more.

ESSAYS ON BLEACHING.

By James Rennie, A. M. Lecturer on Philosophy, &c. &c. London.

No. III.—CHEMICAL AGENTS USED IN BLEACHING.

SECTION I.—*Continued.*

The qualities of water are not of difficult determination, although a chemical analysis of them is none of the least difficult problems in

chemistry. When water is nearly pure, (for no native water is entirely so,) it is colourless and transparent; has no smell, and scarcely any taste. If water have these qualities, it may be pronounced good without farther trial. If it is wished to examine it more minutely, its specific gravity must be taken, which should not much exceed that of rain or distilled water; indeed, the lighter it is the better. Its hardness may be tried by pouring half an English pint or so into a glass tumbler, into which has been previously put a thin slice of Spanish soap, and allowing it to stand for half an hour. If it contains, in solution, any metallic or earthy salts, the soap will be decomposed, and become ropy and curdled. If it be soft, on the other hand, it will be somewhat whitened, but the whiteness will be equally diffused through the whole. Or if it is required to try water instantly, it can be done by a test made by dissolving a little Venice soap in alcohol. The salts of lime, the most common earth which is to be found in water, are easily discovered by the copious white precipitate which they afford, when treated with oxalate of ammonia. Iron may be at once detected, by dropping into the water a small quantity of prussiate of potass, or tincture of galls. If iron be present, the prussiate will produce a blue colour in the water; the tincture will first produce a purple, which will afterwards change to a black. Sulphate of iron, the most common state in which it occurs in our waters, may be discovered by nitrate of barytes, which, in this case, gives a yellow precipitate. On this principle, the importance there is in the choice of water for bleachers, may be strikingly illustrated. Take half a pint of distilled water, add to it a single drop of solution of the sulphate of iron, and a single drop of the tincture of galls, and stir it with a glass rod. It will now present but a very slight change of colour, but add to it half a pint of spring water, and the whole will become instantly black. I have not left room to detail the mode of finding, by analysis, the proportions of substances contaminating water; for this I refer to Thomson's Chem. IV. 212.

I shall conclude the subject of water, by mentioning some of the expedients by which such as may be unfit for the bleacher's use may be improved. I formerly remarked that hard waters have a considerable power of checking the putrefactive fermentation. Now, this holds equally *vice versa*, and can easily be turned to good account in rendering hard waters soft, for abundance of waste vegetables can at all times be easily procured. It is this that renders soft the waters of most lakes, and rivers arising from lakes; for, as they abound in aquatic plants, which are continually destroyed and reproduced, a great quantity of vegetable matter runs into fermentation and softens the water. The effect may be accounted for by the combination of the ammonia and sulphuretted hydrogen arising from the decomposed vegetables, with the earthy and metallic salts which are contained in the water, and render it hard. Dr. Priestley, vol. II, p. 185 of his Experiments on Air, has related a fact strongly illustrative of what we here recommend. He there states on the authority of Mr. Garrick, that the public reservoirs at Harwick are commonly very foul on their sides and bottoms, but contain water which is both wholesome

and pleasant, provided that they are *not cleaned*, for whenever the fæcula, together with the mosses and other aquatic vegetables, are removed by cleaning, the water becomes totally unfit for use till these matters again accumulate in sufficient quantity to purify them. Plants even seem to purify water while *growing* in it; a fact, for the knowledge of which we are indebted to Priestley and Ingenhouz. This seems to be particularly the case with the byssi and confervæ, which fortunately abound in all our waters, unless pains be taken to prevent their growth, under a false notion of cleanliness. (See Priestley on Air.)

Water containing lime may be improved by exposing it in shallow reservoirs to the action of the atmosphere; in which case the carbonic acid of the air unites with the lime, and precipitates it, or causes it to float on the surface. When such water is to be used for any nicer purpose, such as for diluting acids, it may be improved by the method employed by dyers. Put twenty-four bushels of bran into a tub or vat which will contain about ten hogsheads; fill a large boiler with the hard water, which, when just ready to boil, pour into the vat. The acid fermentation will soon commence, and in twenty-four hours it will be ready for use. Berthollet conceives that the acid acts by decomposing the carbonate of lime and magnesia, from which, its acid, being more powerful, disengages the carbonic acid; and that in this way the earthy sediment which is occasioned by boiling is prevented from taking place. (Edin. Encycl. art. Dying.)

When water is rendered hard by the presence of sulphate of lime, it may be purified at a comparatively small expense, by a solution of barytes, for the sulphuric acid having a greater affinity for the barytes than for the lime, will leave the latter to unite with the former.* The solution should be dropped in by degrees, in small portions, till it produces no farther precipitate. If too much should happen to be put in, and this will be shown by its giving a vinous colour to paper stained as Brazil wood or Fernambouc, (Ann. Chem. XXIX, page 321.) it may be readily precipitated by exposure to the atmosphere, whence it will draw carbonic acid, and form a carbonate. When barytes is not to be had, hard water may be softened by the addition of pearl ash or crystals of soda, either of which will combine with the sulphuric acid, and disengage the lime, but not so perfectly as the barytes; besides, the expense of the purification would exceed the advantage derived from it. A cheaper substitute, however, may be found in stale urine, which may be gradually poured into the water till the object is attained. Its offensive odour may be corrected by the previous addition of quick-lime, a mode of sweetening which does not seem to have been known to the Romans, who obliged their scourers to reside in unfrequented parts of their cities. (Plin. Hist. Nat. XXVIII. 5, 6. Parkes.)

The solutions of iron which occur in our waters, are generally sulphates, and are most injurious in every part of the process of bleaching. Water so contaminated must be drawn into a cistern and puri-

* See Nich. Journ. I. 535. The mode of preparing this solution is given by M. Robinquet in the sixty-second tome of the Annales de Chimie.

fied as in the last case, by adding a solution of pure barytés, which will deprive the iron of its solvent, when it will consequently precipitate. The process takes several hours, but when expedition is required, two reservoirs may be constructed, and the process may be commencing in the one, while it is finishing in the other. The workmen, however, ought to be cautious of adding too much of the solution, as, in this way, the water may be left in as bad a state as at first. If the cisterns, however, are made sufficiently shallow, exposure to the air will throw the superabundant barytes to the bottom. Mr. Parkes has ingeniously suggested that, in works in which large steam engines are employed, a considerable quantity of distilled water might always be commanded from the waste steam. "It would only require," he remarks, "a proper receptacle to condense it, and its advantage to the bleacher of fine calicoes for printing would be incalculable." I would add to this ingenious, and evidently practicable suggestion, that although the quantity produced in this way was not very considerable, even a small quantity of pure water produced daily, and *added* to the common water in use, would greatly increase its purity by diluting the contaminating substances.

After all, these expedients are but imperfect, and, in every case, expensive and troublesome. The manufacturer, therefore, cannot be too strongly impressed with the importance of forming his establishment where none of them are necessary—where he may have a constant and copious supply of good soft water.

Section II.—*Of the Vegetable Alkali.*—There is nothing in which the mere manufacturer who is not a chemist is more at a loss than in ascertaining the quality of his alkali; in discovering the proportions of efficient material in a given quantity of the alkali of commerce. To the chemist, however, it is not a task of insuperable difficulty; and he, therefore, ought to lend all the aid in his power to simplify the process of analysis.

The vegetable alkali of commerce possesses very different qualities, according to the manner in which it is manufactured, and the vegetables from which it is procured. This substance may be extracted in greater or less quantity by lixiviation from the ashes of almost all vegetables, and pre-exists in plants previous to combustion; not indeed in a separate uncombined state, but united with the sulphuric and muriatic acids, and sometimes the nitric, but more commonly with a vegetable acid or oil in the state of a neutral salt. These salts seem to be decomposed during combustion, (their own carbon probably acting as a powerful agent,) and the alkaline part is thus set free. When the sulphuric acid is a part of the compound, the combustion sets free its oxygen, and sulphur is produced, which unites with the now disengaged alkali and forms a sulphuret. This substance, Mr. Kirwan says, (Trans. R. Ir. Acad. 1739,) is more readily produced when free access to the air during combustion has not been given. Formerly the potash and pearl ash of commerce were supposed to be pure simple substances. In 1756, Dr. Black proved satisfactorily that they *all* contain a large proportion of car-

bonic acid. This may be shown by a very simple experiment. Pour a little of the clear solution of carbonate of potash in a glass of transparent lime-water, when the lime will be instantly converted into chalk by abstracting carbonic acid from the potash. M. Descroizilles found that American pearl ash consists of a mixture of caustic soda and muriate of potash. (Ann. de Chim. LX. 17.)

This alkali is procured from North America, Russia, and other countries which abound much in forests; and is manufactured by incinerating and lixiviating the wood which is cut down in order to clear the land for cultivation. The pot and pearl ashes of commerce, which differ in the latter being milder in consequence of a superabundance of carbonic acid, are brought to market of three different qualities, but the manufacturer would fall into a gross mistake were he to suppose that those of the first quality, for example, contained a uniform quantity of pure alkali; this can only be learned by the actual analysis of a specimen taken from every parcel he may have occasion to purchase. At the very commencement of the examination of a parcel of ashes by the eye, the bleacher ignorant of chemistry is often much deceived in the estimate he forms of their quality; for, by following an unlucky prejudice, he prefers that which exhibits a red fracture, which can only be occasioned by oxide of iron, or by sulphur. Now, either of these substances, every bleacher knows, will greatly injure the cloth in every stage of the process. In order to humour this hurtful prejudice, some of the manufacturers of alkali in England adulterate with sulphur, to produce this red fracture, and procure a reputation for their goods. By this means, the bleacher is not only induced to give a high price for an inferior commodity, but before he can employ such alkali in any of the nicer operations of his art, he must get clear of the sulphur and the neutral salts which it may have formed. Even the best ashes never contain above 70 per cent. of alkali in a state of purity, and seldom more than 60 or 65. Of the adulterating substances, charcoal is perhaps the most common; but as it commonly exists under its proper appearance, it can readily be recognized by the eye. Water is always present in the proportion of about 5 or 6 per cent. The rest of the foreign substances commonly consist of carbonic acid, sulphate and muriate of potash, and muriate of soda. The last of these is often added by the seller for the purpose of increasing the weight, especially to those which are contained in the casks marked of the second and third qualities. M. Descroizilles informs us that the casks and packages are not always of the same quality in their different points and various pieces; for the ends of a cask and its centre towards the bung, have been found to contain good potash, while the other parts were either of inferior quality, or, what was worse, contained nothing but earth. (Ann. de Chim. LX.)

Several methods have been proposed by eminent chemists for ascertaining the proportion of efficient alkali in the ashes of commerce. If it be required to ascertain whether any lime exists in a parcel of ashes, dissolve an ounce of them in boiling water, and put into the

vessel a single drop of the oxymuriate of mercury; if lime be present, a yellowish brown colour will be produced. (Kirwan.)

Mr. Kirwan (Trans. R. I. A. 1789, p. 15) recommends one founded on the principles that a hot solution of a free alkali, or one combined only with carbonic acid gas or sulphur, can hold no earthy or metallic neutral salt in solution; that alumina cannot be precipitated by the hot solutions of any alkaline neutral salt, but only by free alkali, or such as contains sulphur or carbonic acid gas; that any carbonic acid gas taken up by the alumina, is separated in drying, or may be disengaged by the muriatic acid, and that the strength of an alkali is in proportion to the quantity of any acid required for its saturation. For the analysis, then, procure a pound of alum, reduce it to powder, wash it with cold water, put it into a tea-pot, and pour on three or four pounds of boiling water. Powder an ounce of the alkali to be tried, put it into a Florence flask, with a pound of distilled water, (which the bleacher can have from his steam engine,) boil the liquid for an hour, and filter it. Both this and the solution of alum being heated gradually, pour in the latter till the liquor redden litmus paper. Dry the substance which is obtained by filtering this solution, reduce it to powder, and keep it in a heat of 500° for a quarter of an hour. Place in the same scale of a balance with this, after weighing it alone, an ounce flask filled with muriatic acid, and balance them by weights on the opposite scale; mix the alkali and the acid, blow into the vessel, to expel the carbonic acid gas which may have accumulated, (see Nich. 4to Journ. I. 271,) and mark how much it takes to restore the equilibrium. This, subtracted from the weight of the dry alkali, will leave as a remainder, a weight exactly proportioned to the weight of pure alkali contained in an ounce of ashes; all besides, is foreign matter. This, however, is liable to some inaccuracies, for if quick-lime be present, it will decompose the alum. Whether this be the case, can be discovered by the oxymuriate of mercury, or by the addition of a few drops of any mild alkaline solution, by which it will be readily disengaged. Again; if sulphur be present, it will be precipitated along with the alumina, and increase its weight. This test, however, of the strength of alkalies can never be a standard of much accuracy, unless the acid employed be always of the same strength. This may be done, with sufficient exactness for ordinary purposes, by diluting the acid to the same degree by the hydrometer. Let the test, for instance, consist of one part of acid and five of water. When the mixture has cooled down to the temperature of 60°, observe the height to which the hydrometer rises, and make this the standard for subsequent trials.

M. Descroizilles has given a long account of an alkali meter, invented by him, in the sixtieth tome of the Annales de Chemie, but I do not know whether it has ever been brought into use; a description of it may be also seen in the Philosophical Magazine for 1807.

There has been another method proposed for discovering the purity of the vegetable alkali: put a given quantity of potash into twice its weight of water; stir the mixture during the solution of the salt, and

filter it while warm, through blotting paper, adding gradually, after al the liquor has passed through, a small quantity of cold water to wash out the remaining alkali. What remains on the filter, is sulphate of potash, which, after being dried, must be accurately weighed. The clear solution which has passed through the filter is evaporated in a sand bath, till it is reduced one-third, and set in a cool place for 24 hours; when, if the crude alkali contained muriate of soda, it will be found crystallized at the bottom of the vessel in a regular cubical form, which also is to be dried and weighed. The weight of this, together with that of the sulphate of potash formerly obtained, being deducted from the weight of the crude material, will give the precise weight of the pure alkali which it contains. Pearl ash, being milder than potash, is commonly preferred for any of the nicer processes in bleaching. The pearl ash is prepared by a longer continued calcination of the materials of potash at a low heat, by which the combined sulphur and carbon are expelled or decomposed. The pearl ash of Russia and America, however, contains a large proportion of neutral salts, of which the bleacher must endeavour to deprive it. Several extensive works have lately been established for the purpose of preparing this for the use of bleachers and others; and the article can be afforded as cheap as the foreign, and much purer.

FOR THE FRANKLIN JOURNAL.

MECHANICAL JURISPRUDENCE.—NO. XV.

BY PETER A. BROWNE, Esq.

On the Law of Patents for New and Useful Inventions.

OF THE SPECIFICATION, OR DESCRIPTION.—*Continued.*

With regard to the *language* to be used by patentees in the specification, there are several rules to be observed.

In the first place, the statute does not require the use of any *technical terms*. Lord Kenyon, C. J. in the case of Hornblower v. Boulton, says, "no technical words are necessary to explain the subject of a patent; as lord Hardwicke said upon another occasion, 'there is no magic in words.'"

But the party must set forth his invention intelligibly, in the most clear and unequivocal terms of which the subject is capable.

For this we have the authority of Mr. Justice Rooke in Boulton v. Bull, and Mr. Justice Ashhurst in Turner v. Winter. 1 Term Reports, 602. The latter proves that "it is incumbent on the patentee to give a specification of the invention in the *clearest* and *most unequivocal* terms of which the subject is capable."

There must be nothing put into the specification merely to puzzle. The King v. Arkwright was a *scire facias* to repeal a patent for an invention for certain instruments or machines for preparing silk, cotton, flax, and wool, for spinning. The machines were ten in number. Two of them, Nos. 8 and 9, were of no use; it was contended that

there were two distinct machines; one composed of Nos. 3, 4, and 5, and the other of 6, 7, and 10; that they acted differently; what was proper for the hemp, not being proper for the wool: but this distinction was not stated in the specification. Buller, Justice, on this part of the case, remarked as follows: "What is there *in the specification* that can lead you to say you must make use of *three* things for *one* of the machines, and *three* for the *other*, and which three for one or the other? And even were it so, what is to become of the other four? If those are of no use but *to be thrown in merely to puzzle*, I have no difficulty to say, upon *that ground alone* the patent is void, &c."

The specification is not directed to the ignorant, but to men of the profession to which the invention belongs, or is most nearly allied, and the language should be such as will be understood by men of tolerable skill.

In the case of Arkwright v. Nightingale, lord Loughborough says, "The clearness of the specification must be according to the subject matter of it: it is addressed to persons in the profession, having skill in the subject, not to men of ignorance; and if it is understood by those whose business leads them to be conversant in such subjects, it is intelligible."

This is what is meant by that part of the 3d section of the act of congress, which says, "to enable any person *skilled in the art or science*, of which it is a branch, or with which it is most nearly connected, to make, compound, and use the same."

Lord C. J. Gibbs, in the case of Manton v. Manton, Davis on Patents, 333, says that the explanation should be made so that persons of *tolerable* skill may make the thing by means of the specification.

A specification is not good that requires a man of ingenuity to supply its defects.

In the case of the King v. Arkwright before cited, Buller, Justice, says, "It has been truly said by the counsel, that if the specification be such, that *mechanical men of common understanding*, can comprehend it, to make a machine by it, it is sufficient; but then it must be such, that mechanics may be able to make the machine by *following the directions of the specification*, without any new inventions or additions of their own."

A specification is not good if it requires expense and experiments to aid it.

This was ruled by Buller, Justice, in Boulton v. Bull, where he says, "If the negative appeared, namely, that a mechanic could not, from the specification, make an engine with equal effect, or *if it required expense and experiments* before it could be done, I agree that either of those facts would avoid the patent."

A mere redundancy will not vitiate a specification.

This may be collected from what is said by Eyre C. J. in Boulton v. Bull, 2 Henry Blackstone's Reports, 463. "That if there was a specification to be found in that paper, that went to the subject of the invention as described in the patent, he thought the rest might very well be *rejected as superfluous*."

The Act of Congress requires that the invention shall be so described "as to distinguish the same from all other things before known."

It would seem however to be sufficient, if what is claimed as new appears with *reasonable* certainty on the face of the patent; either expressly or by necessary implication; but it must not be left to minute references and conjectures, from what is previously known or unknown; since the question is not what was before known, but what the patentee *claims as new*. This is the language of Judge Story, in Lovell v. Lewis, 1 Mason's Reports, 188, 189. And whether the invention itself be thus specifically described with *reasonable certainty*, is a question of *law* upon the construction of the terms of the patent, of which the specification is a part. For this rule also we have the authority of Judge Story in the case of Lovell v. Lewis.

It has been decided in England that the articles of the specification which denote *intention only*, and do not state the thing to which it is to be applied, will not maintain an action. For which see the opinion of Mr. Justice Rooke, in Boulton v. Bull. "As to the articles of the specification which denote intention only, and do not state the thing to which it is to be applied, I do not think he could maintain an action for a breach of these articles; for he cannot anticipate the protection before he is entitled to it by practical accomplishment."

How far this would be considered as the law of the United States must depend upon the wording of the act of congress; the 3d section requires the patentee to explain the several modes in which he has *contemplated* the application of that principle or character, by which it may be distinguished from other inventions, &c.

I have not observed any decision in this country on this point.

THE DRAWINGS.

The next thing required by the Act of Congress is that the whole shall be accompanied with drawings and written references, where the nature of the case admits of drawings. The 3d section of the act of 1793 says, "and he shall accompany the whole with drawings and written references, where the nature of the case admits of drawings."

In England no drawing is necessary if the specification is intelligible without it.

In the case of Boulton v. Bull, 2 Henry Blackstone's Reports, it was objected that there was no drawing or model, and Mr. Justice Rooke, in delivering his opinion, says—"The objection is that there is no drawing or model of a particular engine; and where is the necessity for such drawing or model, if the specification is intelligible without it?"

It was before stated that even the specification or description is not expressly required by the statute of James, but that a clause or proviso is generally inserted in the British patents, that, if the patentee shall not, within a stated time, particularly describe and as-

certain the nature of said invention, and in what manner the same is to be performed, by *an instrument of writing* under his hand and seal, and cause the same to be enrolled in the Court of Chancery, then they shall become void. See Harmar v. Payne, 11 East's Reports, 101. Godson on Patents, Appendix, 374. It must be observed that the words are "*by an instrument of writing.*"

But a drawing being an easy way of illustrating the different parts of a machine, it has been the practice to annex them to the specifications made in England, under the above proviso: and they have been mentioned in several decisions which we shall briefly notice.

It was formerly decided that the drawing did not constitute a *principal* or *essential* part of the specification; but that the specification ought to contain within itself all the necessary information, without having recourse to the drawing.* But it has been since ruled, that, if a drawing, or figure, enable a workman of ordinary skill to construct the improvement, it is as good as any written description.

As the Act of Congress makes the drawing a part of the specification, it may be presumed that if the written description and the drawing *together* will enable a mechanic of tolerable skill to construct the machine, it is all that is required. It was also formerly held that when a drawing was introduced, it was indispensable that it should be drawn to a *scale*. See 11 East's Reports, 112, 14. Vez.'s Reports, 130. But this rule has been relaxed, and if a mechanic of ordinary skill can make the machine from the drawing *in perspective*, no scale is necessary. See Godson on Patents, 119.

I am not aware of any American decision which requires the drawing to be executed to a *scale*.

The Act of Congress expressly requires that there shall be written references accompanying the drawing.

SPECIMENS OF INGREDIENTS.

When the invention is of a *composition of matter*, the Act of Congress requires the applicant to deposit in the secretary of state's office, specimens of the ingredients, and of the composition of matter, sufficient in quantity for the purpose of experiment. The words are these—"or with specimens of the ingredients, and of the composition of matter, sufficient in quantity for the purpose of experiment, where the invention is of a composition of matter." 3d section of the act of 1793.

None are required by the English law or practice.

It is a subject of curious remark, that although the Act of Congress, by requiring a sufficient quantity of the ingredients to experiment, seems to contemplate their trial in that way, yet there is no authority in the law for any one to use them in that manner.

*See 37 V. Rep. Arts, N. S. 105 and S. C. 4 Barn: and Ald. Rep. 541. 1 Stark, N. P. C. 201.

OF THE MODEL.

By the Act of Congress the applicant must deliver a MODEL of his machine, *provided the secretary shall deem such model to be necessary.*

The words are—"and such inventor shall, moreover, deliver a *model* of his *machine*, provided the secretary shall deem such model to be necessary." 3d section of the act of 1793.

The things mentioned in the first section as objects of the patent law, are "any new and useful art, machine, manufacture or composition of matter. The part of the act which speaks of the model, uses the word *machine* ONLY.

The act also leaves it in the discretion of the Secretary of State to require the model or not.

In point of practice (as I have understood) they are seldom required.

No model is required under the British statute, or proviso, or practice.

APPLICATION FOR A PATENT IN ENGLAND.

In England the following is the routine to obtain a patent, where there is no opposition.

1. The petition and affidavit (the latter having been sworn to, before a master in chancery) must be left at the office of the Secretary of State for the home department, who refers it to the Attorney and Solicitor General.—2. Thence it is taken to the Attorney and Solicitor General for their opinion, or report.—3. It is taken to the office of the Secretary of State, for the King's warrant.—4. This warrant is carried to the patent office of the Attorney or Solicitor General, who draws a bill.—5. The bill is carried to the office of the Secretary of State, for the King's signature.—6. It is then taken to the signet office, for a warrant to the Lord Keeper of the privy seal.—7. At the office of the Lord Keeper, another warrant is obtained, directed to the Lord Chancellor.—8. Next it is taken to the patent office of the Lord Chancellor, where the patent is made out and sealed.—9. The specification must be acknowledged before a master in chancery, and then must be taken to the Enrolment Office to be recorded.

APPLICATION FOR A PATENT IN THE UNITED STATES.

1. The applicant pays thirty dollars into the treasury, for which he receives duplicate receipts.—2. The petition, affidavit, specification, drawings, &c. together with one of the above receipts, are taken to the patent office, (which is a branch of the office of the Secretary of State) where the patent is made out.—3. The patent is taken to the Attorney General of the United States for his examination and approbation.—4. When the Attorney General has given it his sanction, it is returned to the patent office, where it is signed and sealed, and delivered to the applicant.

Inventors should be very careful in the preparation of their papers, when about to apply for a patent; a very slight inadvertent omission may deprive them of the fruits of all their labour. They should not depend too much upon their own skill or experience; Mr. Godson, very justly remarks, that "a man whose thoughts have dwelt long on the same subject, overlooks many things forming part of a manufacture, which led him to the invention." Prudence will dictate, to call in the aid of others, and it will be obvious, that in making that selection, it will be well to inquire which of his friends possesses, in the highest degree, the combined knowledge of *law* and *mechanics*.

INTERFERING APPLICATIONS.

The next topic of consideration is the proceedings that are to be had upon interfering applications for a patent.

The 9th section of the Act of Congress, provides, "That in case of interfering applications, the same shall be submitted to the arbitration of three persons, one of whom shall be chosen by each of the applicants, and the third person shall be appointed by the Secretary of State; and the decision or award of such arbitrators, delivered to the Secretary of State, in writing, subscribed by them, or any two of them, shall be *final, as far as respects the granting of the patent:* and if either of the applicants shall refuse, or fail to choose an arbitrator, the patent shall issue to the opposite party. And where there shall be more than two interfering applications, and the parties applying shall not all unite in appointing three arbitrators, it shall be in the power of the Secretary of State to appoint three arbitrators for the purpose."

The sole object of this arbitration is to ascertain which of the conflicting applicants is *prima facie* entitled to the patent, and the patent, when obtained, is liable to be repealed or destroyed by precisely the same process as if it had issued *without* objection, or arbitration.

This is the language of Judge Story in the case of Steans v. Barret, 1 Mason's Reports, 174.

A refusal to submit to the arbitration, is not *per se* conclusive evidence that a patent, afterwards obtained, was obtained surreptitiously.

This also was decided in the last cited case. The plaintiff and defendant had conflicting claims for a patent, the plaintiff offered to submit to the award of arbitrators, to be chosen according to the Act of Congress, but the defendant declined, and afterwards took out his patent. Upon an application to the District Court to set aside the patent, it was contended that this refusal to arbitrate, and afterwards taking out his patent, were *conclusive evidence* that his patent was surreptitiously obtained. The Court charged the Jury, that these circumstances, alone, did not support the suggestion. Afterwards, upon a motion for a new trial, this opinion was reviewed; when Story, Judge, expressed himself in the following manner. "The first objection taken to the opinion of the Court below is, in substance, that

the Court ought to have directed the Jury, that the refusal of the defendant to submit the claim to arbitration, under the circumstances detailed in the evidence, (which brought it within the 9th section of the patent act) and subsequently obtaining a patent after the plaintiff had obtained his, was *conclusive* evidence that the patent of the defendant was obtained surreptitiously, or upon false suggestion; whereas the court held, that these facts were not *per se conclusive* to establish this point. In my judgment, there was no error in this opinion of the Court. If an arbitration had been actually perfected between the parties under the 9th section, the award or decision of the arbitrators would have been final between the parties, only so far as respected the granting of the patent, it would not have concluded the parties from showing in the present suit, that it was obtained upon false suggestions, it would not have concluded them in an action for an infringement of the patent, from asserting any defence allowed by the 6th section of the patent act. The sole object of such an award, is to ascertain who is, *prima facie*, entitled to the patent; but when once obtained, the patent is liable to be repealed, or destroyed, by precisely the same process, as if it had been issued without objection. If the award itself would not have been conclusive, *à fortiori*, a refusal to join in an arbitration under the statute can not be so."

In England, the practice is somewhat different, with respect to interfering claims for a patent, for the same invention. The opposing party enters a *caveat* at the office of the Attorney and Solicitor General, and upon notice given an examination takes place, and a separate audience is given by one of these officers to each party, after which, report is made to the king. If the party entering the *caveat* is not satisfied with the decision of the Attorney or Solicitor General, an audience may be had before the Lord Chancellor, who examines and decides upon the pretensions of the parties. If the applicant thinks he is unjustly deprived of a patent for his invention, he may, after being heard by the Lord Chancellor, take a *scire facias* to repeal the patent that has been sealed.

OF THE REFERENCE TO THE ATTORNEY GENERAL.

The 1st section of the Act of Congress requires, that the letters, before they pass the signature of the President, and the seal of the United States, shall be delivered to the Attorney General of the United States, *to be examined;* who, within fifteen days after such delivery, *if he finds the same conformable to the Act*, shall certify accordingly, at the foot thereof, &c.

Judge Story is of opinion that it was probably with a view to guard the public against the injury arising from defective specifications, that the statute requires this examination by the Attorney General; but he admits, that, in point of practice, this must unavoidably be a very insufficient security. See Whittemore v. Cutter, 1 Gallison's Reports, 429. It does not seem that the Act of Congress intended to invest the Attorney with any *judicial* power.

In like manner, in England, the Secretary of State for the

home department, refers a petition for a patent, to the Attorney or Solicitor General, who gives a certificate, that inasmuch as it is at the hazard of the petitioner, whether the invention be new, or will have the desired success, and as it is reasonable that his Majesty should encourage arts and inventions, it is therefore, his opinion, that the letters patent should be granted, provided the proviso before mentioned be enrolled in the Court of Chancery, &c.

ENGLISH PATENTS.

Patent granted to James Ogston *and* Thomas Bell *of London, watch makers, for improvements in the manufacture of watches of different descriptions. Communicated by a foreigner.* Dated Jan. 6, 1826.

The object of this method of constructing watches, is to make them considerably thinner than those in common use, without diminishing the force of the impelling power.

The great obstacle to the reduction of the thickness of watches, lay in the main spring; as it is evident, that, if its breadth were reduced, one half for example, in order to make the watch thinner, its power must also be one half less than it was originally. This difficulty is surmounted in the watches for which this patent is granted, by using two main springs in them, each of half the breadth required for the force necessary for the motion, instead of one of the usual breadth.

On the external cylinders of the boxes of these main springs, toothed rings are formed, each containing seventy-five teeth, which work into a deep leaved pinion in the centre of the watch, that is fixed on the same axle with the large wheel which gives motion to the rest of the train. That the two main springs may lie closer to each other, the toothed rings are formed at different elevations on their respective cylindrical cases, and each of them has a ratchet wheel, about the same diameter as its box, attached to its axle, and furnished with a spring click, or catch; and the two are turned round together to wind up the springs, by means of a third ratchet wheel, the teeth of which interlock with the other two, which third ratchet wheel has a square head on its axle, for the reception of the watch key. The patentees state that this square head is contrived so as to admit the key to go deeper on it than what is usual, by which it will be less liable to be broken; but their manner of explaining how this is effected, not being very clear, we are not quite sure that we are accurate in supposing it to be done by surrounding the square head with a small hollow cylinder, attached to the ratchet wheel itself, and working in the frame plate in the manner of a pivot. The same effect might also be produced, by making the end of the key a solid square prism, and forming a corresponding cavity for it, in the axle of the ratchet wheel itself, sufficiently large for this purpose.

Watches of this kind, as may already appear from what has been mentioned, have no fusee wheels, or chains; and in order to supply their effect, the main springs are made tapering from the axle to the outer coil; which, the patentees assert, will effectually equalize the motion. Horizontal, or duplex escapements are advised to be used with them; but their other parts do not so materially differ from those in ordinary use, as to require a particular description for our general readers, although those who intend to make watches of this kind, may find the more particular information respecting them worth notice, which the specification details with great minuteness.

We have now only to add, that the patentees advise these watches to be jewelled in the usual parts, and to mention, what was before implied, that in them the winding up of the main springs is effected, by turning round the axles to which they are attached, instead of making their boxes revolve, according to the general practice.

The above seems an ingenious method of effecting the intended design; and we have only to observe, with regard to the tapering main springs, that, in the first place, this manner of forming them is no new invention, having been used for *pendules*, or chamber clocks, for a considerable time in Paris; and secondly, that we have some doubt of their having the effect asserted, as from the spiral spring acting in all its parts simultaneously in turning round the box, the weakening any one part of it, could, as we conceive, only diminish the general effect, instead of making its energy less at a particular part of the revolution; and we cannot allow the good performance of the watch, to be a decisive proof in support of the contrary opinion, as it has been well known, that the regularity of a watch depends almost entirely on the perfection of the escapement, and very little on that of the other parts. In 1776 M. Peter Leroy made a chronometer, without any fusee and chain, which performed exceedingly well, in which he relied entirely on the excellence of the escapement, and used only a common main spring, of equal breadth and thickness in every part of its extent. We think, however, that the question might be easily determined by experiments of a different description.

[*Repertory of Patent Inventions.*

Patent granted to Hugh Evans, *Harbour-Master of the Port of Holyhead, North Wales, for a method, or methods, of rendering ships and other vessels, whether sailing or impelled by steam, more safe in cases of danger by leakage, bilging, or letting in water, than as at present constructed.* Dated Feb. 7, 1826.

The chief object of the above patent, is to make the lower deck of the ship, or orlop-deck, impervious to water from beneath, and so securing it in other respects, as to enable it to serve as a second bottom in supporting the vessel, in case of the primary, or external bottom being damaged so as to occasion dangerous leaks. This lower

deck is made to have the properties mentioned, by having additional beams put in, with knees both above and below them, and strong stancheons to support them, and by being ceiled, or planked underneath; which ceiling, as well as the ceiling or internal planking of the sides, is to be well calked, so as to be water tight; and the spaces between the timbers or ribs of the vessel, where they come in contact with the lower deck, are to be also filled up and calked for greater security; moreover, to produce greater strength in this lower deck, it may be made convex, or rounded like the external bottom, "with a curvature of one inch in every four feet." Passages, or hatchways, are also to be made through this lower deck, under the hatchways of the other decks, and to be secured by well calked shutters underneath, in addition to those above them.

Besides being defended by this lower deck, or second bottom, the ship is also to be farther secured by strong water-tight bulkheads, or transverse partitions; of which two at least should be made in every vessel, but more may be added according to the nature of the cargo, or the purpose for which it is intended. These partitions are to be constructed of strong uprights passing from the floor timbers to the beams, as close together as is necessary to resist the pressure of water, secured by chocks both above and below, into which they are to be dovetailed, and are to be planked and calked at both sides; and where the partitions join the sides of the vessel, battons are to be fastened at the angles, to make the whole more staunch and secure.

In ships of war, and large vessels, the patentee farther recommends another partition to be constructed, the whole length of the ship, fore-and-aft, directly over the kelson, which is to be planked and secured, in all respects like those already described.

The hold will be divided into several compartments by the transverse partitions, from each of which two pipes are to go to the pump well, one at each side of the kelson, which pipes, as well as the apertures made through the limber boards for the water, are to be furnished with "sluices," or paddles, with rods passing up from them to the upper deck, by which they may be raised or lowered; which arrangement will permit the water from any one of the compartments to be pumped out, independent of the rest.

Steam boats, as well as other vessels of a smaller size, are to have two transverse water-tight partitions, in addition to the lower, or second bottom, secured as before mentioned; and in them these partitions are to be covered at the side next the steam engine with fire tiles, as the sides of the vessels should also be within the same compartment, to stop the progress of accidental fires; which in vessels thus constructed can be speedily extinguished, by having cocks or valves opening from without, made so as to admit the water in sufficient quantity into the steam engine chamber; from whence the water-tight partitions, and the well calked internal planking of the vessel, will prevent its passing into the other compartments of the vessel, so as to preclude all danger of its being sunk by their being filled.

The safety of seamen demands every encouragement to be given to effectual plans for making vessels secure from foundering through the effect of leaks; an accident that we believe happens much oftener than is suspected. Security to the cargo is also a very material consideration, since an insurance can at most only repay the first cost, but cannot extend to the time lost by the failure of the venture, and the consequent loss of profit, or interest of money; and security against fire is also of the utmost importance, as it is perhaps the most appalling calamity that can happen at sea.

We doubt, however, the novelty of the principal part of the plan of the patentee, consisting of the water tight deck, which serves as a second bottom to the ship; as decks, or internal bottoms of this sort, were constructed many years ago by Mr. Barnard, in several vessels; of which an account may be seen in the second volume, p. 185, of the Transactions of the Society for the Encouragement of Arts, &c.

The curved form for these decks may, however, be new; but both they, when thus made, and the water-tight transverse partitions, would be much objected to by seamen, from the interruptions which they would cause to stowage; and moreover transverse partitions of this sort have been used from time immemorial by the Chinese, in their large junks, or merchant vessels. [*Ib.*

To William Duesbury, *of Bosel, in the County of Derby, Colour Manufacturer, for his having discovered a mode of Preparing or Manufacturing of a White from the impure native Sulphate of Barytes.* Dated September, 1825.

The object of this invention, appears to be the production of a material intended to be employed as a substitute for white lead in painting, which material, when prepared according to the process of the patentee, is found not to be susceptible of decomposition, or of changing its hue in situations which are exposed to damp or sulphurous effluvia. It is, however, more particularly designed for water colour than for oil, and when employed on flatted or distempered walls, and as the ground washes, or in the patterns of printed paper hangings, it is found to be a *constant white*, that is, to retain its snowy hue unimpaired and unaffected by any chemical action, to which a humid atmosphere might expose it.

The patentee takes the impure native sulphate of barytes, or what is commonly known by the names of cawk, heavy spar, ponderous earth, terra ponderosa, vitriolata, marmor metalicum, &c. which materials are to be found in several parts of this country in large quantities.

These are to be picked and washed as clean as may be from impurities, and then ground or otherwise reduced to minute particles in a pan or colour-mill, or other proper apparatus, with the addition of

water. The cawk, so ground, is then to be transferred into a leaden cistern or boiler, and more water added to it.

The cistern or boiler should be supported upon iron plates, having a proper fire-place and flues underneath, constructed in brick-work, as usual, in order that the contents may be brought to a boiling heat. To the cawk thus boiled, a quantity of sulphuric acid is to be added, the proportion of which to the cawk, must depend upon the quantity of iron supposed to be contained in it, but this, however, may be ascertained, by taking portions of the cawk out from time to time during the boiling, and examining it, in order to discover whether it has attained the proper degree of whiteness; and if not, more acid must be added, and the boiling be continued, until the desired colour be produced, the materials being frequently stirred during the process, to prevent their adhering to the bottom of the boiler. The prepared cawk must now be repeatedly washed with water, until the solution of iron is removed from it, and then dried in a stove, or by any other convenient process, to fit it for use. Under some circumstances the patentee employs other acids instead of the sulphuric, or compounds of acids with such bases as will act upon iron, with the intention of dissolving the iron, but in general he prefers to use the sulphuric acid in the manner above described.

In the event of employing other acids, or such other compounds as would act chemically upon the leaden boiler, vessels of glass or earthenware properly glazed, or of other materials not liable to be attacked or corroded by the said acids, or their compounds, must be used instead of the leaden boiler. It is stated that copper boilers may be employed instead of leaden ones, even when using the sulphuric acid to dissolve the iron, but the preference is given to those boilers which are formed of lead.

The patentee says, in conclusion, "I do not mean or intend hereby to claim, as my invention, the apparatus herein described, but solely to limit my claim to the purification of the impure native sulphate of barytes, or by what other name it may be called, from its colouring matters, by the action of acids or their compounds, and rendering the same equally fit for those purposes to which white sulphate of barytes is usually or may be applied in the arts."

[*London Journal of Arts and Sciences.*

To William Henry James, *of Coburg Place, Winson Green, near Birmingham, in the County of Warwick, Engineer, for his Invention of certain Improvements in the construction of Steam Boilers for Steam Engines.* Dated December, 1825.

There are two principal objects proposed by the patentee in this invention, the first of which, is to expose a very extended surface of boiler to the action of the fire, in order that a great quantity of steam may be rapidly generated in a comparatively small vessel; and secondly, to prevent the dangerous consequences that frequently attend

explosions in the event of any part of the boiler becoming fractured; which is to be effected by constructing the boiler of many distinct chambers or vessels, combined together, in order that any fracture in one part of the boiler, (that is in one of the distinct vessels) may not communicate to the other parts of the boiler, so as to rend the whole, and by which contrivance only a small portion of steam and water, could be discharged, in case any such accidental explosion should take place.

This boiler appears to be designed principally for a locomotive engine, or steam carriage, and is intended to be combined with other improvements relative to those machines, for which the same inventor has previously obtained patents (see our IXth and Xth volumes.) It is expected from very satisfactory experiments which have been recently made by the patentee, that he will shortly exhibit his invention in operation, we shall then take the earliest opportunity of communicating the results to our readers, and also our own opinions as to its novelty and practical usefulness.

The patentee states, that this improvement in the construction of boilers for steam engines, consists, "first, in forming the said boilers by combining a series of annular tubes, or a series of ring-formed chambers; which chambers communicate with each other by apertures running through the whole series, in order to allow the water and the steam to flow freely from end to end of the cylindrical vessel so formed by the combined tubes or chambers; and which vessel, has a furnace adapted, within it, for the purpose of heating the water, and the steam contained in the annular tubes or chambers. Secondly, in a contrivance by which the boiler may be made to revolve, or to oscillate for the purpose of cleansing its interior from sediment or incrustation, caused by the boiling of the water.

Through the series of annular tubes or chambers, apertures are to be made lengthwise along the top and bottom, for the purpose of obtaining free passages by which the water and steam may flow, thereby forming the whole series of annular chambers into one vessel, of capacity, which is to be occupied with water rather more than half way up.

A furnace is to be inserted within the cylinder, supported upon suitable bearings, and capable of sliding in and out, which with its flue occupies the whole interior of the cylinder of rings, and the flame and heated vapour arising from the furnace in passing from thence to the chimney, enters the jacket and embraces the external surface of the combined ring formed chambers or cylindrical vessel. By these means the water in the lower parts of the vessel is made to boil, and the steam generated therefrom rising into the upper parts of the vessel, becomes greatly increased in its elastic force by the immediate action of the fire, and the jacket is coated with pulverized charcoal, or other imperfect conductor of neat, for the purpose of preventing its radiation.

As it may be found that the water in boiling deposits earthy matter, which adheres as a crust to the interior of the vessel, it is proposed to place at the bottom part of each chamber a few shots, mar-

bles, or other loose articles, in order to clean the interior of the boiler by friction, and to assist this object, it is contrived that the boiler shall be capable of revolving, or vibrating. When it is wished to clean the boiler, the furnace must be withdrawn, and the steam and water pipes unscrewed, then (having nearly filled the chamber with water) by manual labour applied to the handles, the boiler must be caused to revolve, or to vibrate to and fro upon its axle, and guide-rollers, when by the friction of the shots above described, the incrustation or sediment, will be broken up and discharged, with the water employed in washing it.

It has been found desirable to adapt a revolving cock, to give such supplies of water to the boiler, through the supply-pipe, as may be found necessary. This is proposed to be actuated by a movement from the engine as is usually done. By this particular construction of cock, when even the water in the boiler is above the desired level, it flows up to the aperture of the cock, and prevents a further supply from passing; but when the water in the boiler is below its desired level, then a supply is delivered every time that the cock revolves. The steam rising into the upper parts of the chamber of the boiler, escapes through the bent tube, and proceeds by the pipe to the engine.

The patentee says, in conclusion, "I wish it to be understood that I do not limit my claim of invention to the precise forms exhibited in the figures of the parts of which this my improved boiler is constructed, as the tubes or chambers may be eliptical, or of other forms slightly deviating from a circle. Neither do I mean to limit myself to such tubes as are square in their sectional figure, as round or other formed tubes united together would answer the purpose. And although I prefer the construction and forms exhibited in the figures, yet I should consider the above variation to be imitations of my invention, in case a boiler for a steam engine was constructed, by combining a series of annular tubes or ring-formed chambers, with passages extending through the whole series, for the purpose of allowing the steam and water to pass freely from one to the other. And, lastly, I claim the manner of mounting such boiler, to be turned round or made to vibrate, in order to clean their internal surfaces from sediment or incrustation." [*Ib.*

To William Mayhew, *of Union Street, Southwark, in the County of Surrey, and* William White, *of Cheapside, in the City of London, Hat Manufacturers, for their new invented Improvement in the Manufacture of Hats.* Dated Auugust, 1826.

The patentees observe that there are two objections to what are called silk hats as usually made, viz. that the hardness of the body, or shell of the hat, over which the silk covering is laid, frequently hurts the head of the wearer; and the edge of the crown being much

exposed to blows, the silk nap soon becomes worn off, and exposes the cotton foundation of the covering, which being a vegetable material, is not capable of receiving so good a dye as the silk, and the hat immediately looks shabby. To remedy these defects, therefore, is the object of the present patent.

The hat body is to be made of stuff or wool as usual, and the unyielding stiffness of the inner part round the brim, is proposed to be relieved by attaching a coating of beaver or fur, on the under side of the brim, which will render the hat soft and pliable. Round the edge of the tip or crown, a quantity of what is called stop wool is to be attached, by the ordinary operation of bowing, which will render the edge soft and elastic. The hat is afterwards to be dyed of a good black colour, both inside and outside. And then being properly stiffened and blocked, is ready for the covering of silk.

The plush employed for the covering of hats is a raised pile or nap of silk woven upon a cotton foundation; and the cotton being incapable of receiving so good a dye as the silk, presents a disagreeable brown appearance when the silk nap is worn off. The patentees therefore propose to make the foundation of the plush, which shall be employed for covering the tip or top of the crown, entirely of silk as well as the pile: and by that means cause the edges of the hat to preserve their colour, in the event of the nap being injured by blows, or worn off: which indeed is not very likely to take place in these improved hats, the edge of the crown being padded as above described, with a soft elastic material. [*Ib.*

A new method of bleaching and preparing Flax. By the Rev. J. B. Emmett.

On account of the great distress which prevails in most of the manufacturing districts, I have been induced to present to the public the following means of bleaching and preparing flax and tow, by a simple, easy and cheap process, whereby it is reduced to a beautiful degree of whiteness, becomes possessed of a silky lustre, and is made sufficiently fine to be manufactured into the finest goods; hoping that it may become the means, in the hands of opulent manufacturers, of giving employment to some of the workmen, who are unable to meet with it.

The process is as follows: Steep or boil the flax or tow in a weak solution of subcarbonate of potash or soda, in order to extract the colouring matter, resin, &c. I prefer the subcarbonate to the pure or caustic alkali, because, however diluted the latter may be, its powers of corrosion are so great that if it extracts the extraneous matter perfectly, it will almost certainly diminish the strength of the fibre; whilst I find that it may be thoroughly extracted by the former, without producing any such effect: this I have proved by experiments made upon rather large quantities. Wash it thoroughly from the alkali.

The bleaching liquor is prepared in the following manner: Reduce perfectly fresh burnt charcoal of soft porous wood, as willow, or fir, to a very fine powder; tie up the powder in a bag made of cloth of a close texture; immerse it into cold soft-water, and work it by pressing it with the hands, until such a quantity shall be diffused through the water, that on rinsing a little flax through it for a few minutes, and then withdrawing it, it shall be lightly blackened. Put into it the flax to be bleached, taking care that each parcel shall imbibe it to its middle. When all is put into the liquid, the water, on being well agitated, ought to be clouded by the charcoal. I cannot specify the exact proportion, as I observed it no further than this,—that I always used more than was actually requisite: in bleaching 6 or 7 pounds, I never used more than half an ounce. Agitate the liquid, and press the flax under it several times in the day, in order to bring as much charcoal as possible into contact with it. After about twenty or twenty-four hours, remove it from the liquid, having it well rung, put it into a second, which may contain less charcoal: agitate as before, and after the same interval of time, examine a small parcel by washing it with soap and hot water: if the colour be good, remove it from the charcoal-liquid; if not, allow it to remain another day, or until it becomes white: two or three days are amply sufficient if the process be well conducted. It is advantageous to spread it out thinly upon the grass, wet as it is, and having the charcoal in it, taking care to turn it frequently for a few days: the charcoal gradually disappears, and the surface acquires a pearly appearance.

The flax is now to be rinsed in a large quantity of water: then to be washed thoroughly with soap in hot water, till it is quite clean; the soap must then be washed out by cold water, and the flax dried; if on the grass, exposed to the sun and air, the better.

Before washing out the charcoal with soap, the lustre of the fibre will be improved by steeping it for eight or ten hours in water just soured with sulphuric acid; if this process be continued too long, the fibre will be weakened. The acid-steeping is not essential, except the flax be intended for some particular uses.

The charcoal is easily washed out, and that perfectly, with soap. The ultimate fibres are perfectly separated: they are so much finer than silk, that I use them in the quadrant, transit, and micrometers: the lustre is precisely that of silk; the strength of the fibre is not at all impaired. It takes such colours as I have tried—blue, pink and yellow—perfectly. The finest thread may be spun.

Having made public the process, and particularly on account of my reason for so doing, I hope that manufacturers and others who can forward the introduction of the material, will bestow some attention upon the subject.

P. S. It may probably be worthy the attention of the Irish; and particularly since the process may be performed by individuals at their own houses, and may give employment to many paupers in the work-houses.

Annals of Philos.

On an improved mode of Etching Steel Plates.

By Mr. W. Cooke, *Jun. Engraver.*

From the Transactions of the Society for the encouragement of Arts, Manufactures, and Commerce.

Dec. 21, 1825.

Sir—As the Society of Arts have given a portion of their attention to the subject of engraving on steel plates, and as many experiments have failed, I feel great pleasure in making the following communication public through the medium of the society.

For the best mode of biting-in, hitherto published, we are indebted to the great perseverance of Mr. Turrell; but the difficulty and danger of using his menstruum on a soft ground, or when the varnish is not sufficiently dry, induced me to use the acids in different proportions, and to leave out the alcohol, as the composition was found to act on the ground, causing the whole surface of the plate to be corroded; this has frequently happened.

It is necessary to mention, that all plates for landscape engraving should be made of steel not completely decarbonized.

I beg to submit a few preparatory directions previous to etching.

The steel should be carefully cleansed (before laying the ground) with turpentine only, omitting the whiting which is used in preparing the surface of copper.

The ground should be laid with as little heat as possible, steel needing not so much as copper; too high a temperature decomposes the ground, and occasions it to produce small air bubbles, or to evaporate in a light smoke from the surface of the plate; should this take place, the ground must be re-laid. It is also highly necessary that in etching the point should penetrate the surface of the steel, and the breath not be suffered to condense on the etching, as it will cause the lines to rust, and will prevent the acid from biting well. The plate being ready for biting-in, the process is as follows:—mix, by gentle shaking, six parts of acetic acid, and one part of nitric acid.

This mixture, being very rapid in its action, should be taken off the plate at half a minute, and the acid well washed out of the lines with water, drying the plate well, but without the assistance of heat. Stop out the light tints with Brunswick black varnish; and then, for the purpose of washing the oxyd out of the lines, pour on the plate a mixture of six parts of water, and one of nitrous acid, letting it remain two or three seconds; take this off, and immediately repeat the former mixture without washing the plate between, with water. This process should be repeated for each tint.

The biting-in of a steel plate should be accomplished, if possible, in one day: this observation holds good in regard to other methods of biting, as the lines will sometimes attract oxygen from the atmosphere during the night, which will prevent their biting with the same degree of clearness as the day before.

When the biting is completed, and the ground taken off, with a strong tooth-brush and turpentine, clean out the remaining oxyd from

the lines, using the fingers for the light tints; then rub the surface of the plate, to remove the bur, with the finest emery paper previously well used on the back of a steel plate to take off its roughness; the more this paper is used the more valuable it becomes for taking out the marks of the scraper from dry point tints.

Re-biting is performed by dipping a clean rag in a very dilute nitric acid, and rubbing it over those parts intended to be re-bitten until the surface becomes dull; clean the plate out as before-mentioned, and in laying the ground the dabber should be used but little, as it is likely to take up the ground again; re-bite with a few drops of nitrous acid in four ounces of water, sufficient to make the water taste sharply of the acid.

The whole process for biting, or re-biting, should be performed in a temperature of about sixty degrees, or higher, and certainly not much below that point.

As the time required to bite-in is the principal thing to be observed, all the light tints should be tried every minute after the first biting; but the deeper ones will require a longer time. A little practice will show these remarks (apparently trifling) to be important.

Biting on very soft steel plates may be accomplished by using the following mixture:—three ounces of warm water, four grains of tartaric acid, four drops of nitric or sulphuric acid, one drachm of corrosive sublimate

I also submit to the society a new method of graduating skies and other tints.

Incline the plate, by tilting it with two wedges, and pour the rebiting acid into a glass funnel, with a stick inserted in the tube, and kept steady by a twisted copper wire loop; drop the acid on the dark part, and according to the colour of the tint the acid should be made to drop faster or slower, which is regulated by the raising and lowering the stick in the centre, and gives to the acid a tremulous motion, until it is floated over the whole sky; this obviates the old method of sweeping or feathering, which, from the quick action of the acid, occasions streaks to appear in the tints when the ground is taken off.

It is important that engravers should make use of the best acids, and perfectly free from adulteration. From the cheapness of sulphuric acid it is sometimes used with muriatic, to adulterate the nitric acid. The following tests will discover them :—dissolve a little nitrate of barytes in distilled water, and add it to a small quantity of the nitric acid in a phial or test tube; if a white precipitate is discovered at the bottom, sulphuric acid is present; and muriatic acid will form, with a solution of nitrate of silver, a white cloudy precipitate; should either of these effects take place, the acid is not fit for use.

The purest acids are those manufactured by Mr. Remnant, Smithfield-bars, who has made them some years for the use of engravers.

Since writing the foregoing account, I have discovered means of making the ground adhere to the surface of the steel, without using acid to dull the surface.

Dissolve, by gentle heat, (in a Florence flask,) some powdered copal in oil of spike lavender, and evaporate to a thick consistence;

then to one ball of ground, add about one drachm of the copal solution, each having been made warm previous to mixing; lay the ground as before mentioned, avoiding too much heat; the ground may then be laid with the same facility as on copper.

I am, sir, &c. &c.
W. Cooke, Jun.

A. Aikin, *Esq. Secretary, &c.*

The above processes were performed on tinted steel plates, in presence of the committee of polite arts, to their entire satisfaction, and that of several engravers, who were specially invited to witness them.

On a Menstruum for Etching Plates of Soft Steel.
By Mr. W. Humphrys.

From the Transactions of the Society for the encouragement of Arts, Manufactures, and Commerce.

April 19, 1826.

Sir—I have a communication to make to the Society for the promotion of Arts, Manufactures, and Commerce, of a menstruum for biting-in steel plates. I have for some time back communicated it to various artists, to get their opinion of its merits, and have the testimony of Messrs. Turrell, W. Finden, &c., that it is the best, cheapest, simplest, and safest in its operation of any acid yet discovered; and those gentlemen will be happy at any time to meet a committee to explain its qualities. In addition, I have specimens of its performance, from several engravers, to lay before the society.

I am, sir, &c. &c.
Wm. Humphrys.

A. Aikin, *Esq. Secretary, &c.*

The composition of the menstruum is as follows:

Take a quarter of an ounce of corrosive sublimate powdered, and a quarter of an ounce of alum powdered, and dissolve them in half a pint of hot water.

Directions.—Let it cool before use. While using it, keep it stirring with a camel's hair brush, and take care to wash the plate perfectly, after each biting. As this acid, though clear before use, becomes turbid during its action on the steel, it may be prudent, in fine works, to throw away each portion of acid after it has been on the plate. The taste and experience of the artist must dictate the length of time he may leave it on his plate; delicate tints are obtained in about three minutes.

It appears from the experience of those artists who have practised engraving on steel, that several of the menstrua employed in the process technically called biting-in, will succeed with hard steel, but give results by no means so satisfactory, when employed on very soft, or nearly decarbonized steel. Nitric acid is the essentially active ingredient in all these menstrua; and the chemist well knows that

when this substance is brought into contact with iron, it usually brings part of it to the state of protoxid, which is soluble in the acid, and also reduces a smaller portion to the state of peroxid, which remains, for the most part, undissolved, adhering to the surface of the iron, and thus preventing that deep, clean, uniform biting which it is the great object of the artist to obtain. The presence of carbon, in a finely divided state, has a tendency to prevent, or at least to retard, the peroxidation of the iron, and this, probably, is the reason why it is less difficult to gain a good result with hard, than with soft, or decarbonized steel.

The composition employed by Mr. Humphrys contains no nitric acid; and, from the testimony before the committee of Mr. W. Finden, Mr. Warren, Mr. Romney, and others, who have tried it, and also from the result of experiments made in presence of the committee, appears to be superior, for biting-in on soft steel, to any menstruum that has hitherto been used.

On Fustic, (Morus tinctorius) *and its application to the Dying of Yellow, Green, Olive and Brown.* By E. S. George, Esq. F.L.S.

The wood of the Morus tinctorius is employed in dying those shades of yellow, in which intensity of colour is of more importance than brilliancy; and in all the range of colours formed by the mixture of yellow, blue and red.

For those colours in which sulphate of indigo (indigo dissolved in sulphuric acid) is employed to give the blue, it is of great value, resisting the action of free sulphuric acid in a higher degree, than any other yellow colouring matter.

The colouring matter of fustic, is seldom employed in the dying of yellow; the only case in which it is so employed, is as a cheap substitute for weld, or quercitron; but for woollen goods intended to be dyed a true green in the indigo vat, the required shade of yellow is first given by means of fustic.

The dying vessel may be of iron; and for 120 yards of woollen cloth, weighing 1 lb. 4 ounces to the yard, 45 lbs. of fustic in chips, with 6 lbs. of alum, will be found sufficient for ordinary shades of green. If the shade required, be bright, 4 lbs. of solution of tin may be added with advantage; but for bottle green, an additional proportion of fustic will be required: some dyers use the fustic alone, without any mordant, and the affinity of woollen fibre for the colouring matter of fustic, is sufficiently powerful to fix the whole. The addition of a mordant, however, gives much greater durability. After the fustic and alum have been boiled a few minutes, in a dying vessel, containing from 300 to 400 gallons of water, 20 gallons of cold water are added, and the cloths entered, turning quickly a few minutes, and afterwards more slowly, and boiled from fifty minutes to an hour. They are afterwards well washed, and the requisite shade of blue, given in the indigo vat.

Fustic is employed in all the shades known as Saxon green. In this class of colours the blue is obtained from indigo, but by means of its solution in sulphuric acid, known by dyers as *chemic*. The long list of substances employed by the old dyers and chemists, in making this solution, are almost entirely discarded, and sulphuric acid and indigo are the only substances now employed. In making the solution of indigo for greens, an excess of sulphuric acid should be avoided, as it prevents the yellow colouring matter fixing upon the cloth. I have found 9 lbs. of sulphuric acid to 1 lb. of indigo of good quality, the best proportion.

For the dying of 100 lbs. of worsted goods, known as wildbores, a bright green:—In a leaden vessel containing 300 gallons of water; when at the temperature of 150° Fahrenheit, I threw in 25 lbs. of alum and 2 quarts of bran, carefully removed the impurities that rose to the surface until the water boiled, then added 2½ pints of sulphate of indigo, 12 lbs. of fustic in chips, and 10 lbs. of white Florence argol (super tartrate of potash,) boiled the whole five minutes, added 20 gallons of cold water, and entered the goods turning quickly for ten minutes, and then more slowly, at the same time raising the temperature to ebullition. After boiling 45 minutes, found the colour scarcely so full as required, and took out the goods, adding half a pint of sulphate of indigo, and 4 lbs. of fustic, again entered, and boiled half an hour. Fresh goods may be dyed in the same liquid; indeed, in conducting a dying house economically, it is of great consequence so to arrange the colours that they shall follow each other without emptying the dying vessels, as thus a great saving of dying wares is achieved. For 100 lbs. of the same description of goods, and the same shade of colour, added 15 lbs. of alum, 2½ pints of sulphate of indigo, and 7 lbs. of argol; after entering and boiling as before 45 minutes, took out the goods, added half a pint of sulphate of indigo; entered and boiled 20 minutes. It is of importance, that the whole of the indigo should not be given at first, since from the boiling necessary to give evenness to the colour, the lustre is considerably impaired; by adding a part towards the close of the process, both evenness and beauty of colour, are ensured. For a third quantity, the same colour, 12 lbs. of alum were added, and the amount of alum in a fourth and fifth quantity, must gradually diminish to 6 lbs. The amount of fustic and argol is to be gradually reduced, the proportions depend, however, upon the discretion of the dyer; the proportion of sulphate of indigo remains the same, the whole of the blue colouring matter being removed from the dying vessel at each operation.

It is not adviseable to continue more than six parcels of goods without emptying at least one half of the contents of the dying vessels, and filling with fresh water; but shades of olive or brown, must succeed without any addition of water.

For all shades of olive, and brown, which may be considered as the same colour, only varying in the proportions of red, yellow or blue, entering into their compositions; fustic is employed for the yellow, the blue is given by sulphate of indigo; and for the red, madder is used for all the light shades of bronze approaching to green, and

camwood for the darker shades of olive and brown. I shall, without further observation, state some processes.

The light and green shades of bronze, are generally dyed after green, in the same liquor. For 126 lbs. of worsted stuffs after light green, added 24 lbs. of mull madder, 14 lbs. of fustic in chips, 4 lbs of alum, 3 lbs. of red argol, 2 lbs. of sulphuric acid, and 1 pint of sulphate of indigo; boiled the whole together 10 minutes, added 20 gallons of water, entered the goods, turning quickly, and afterwards more slowly, boiled one hour and thirty minutes, took out the goods and added 3 measured ounces of sulphate of indigo, entered and boiled thirty minutes. With olives, and indeed, all the colours in which sulphate of indigo is employed, except the red browns, it is of consequence that a portion should be added towards the close of the operation; thus increasing the brilliancy of the blue parts of the colour, which is impaired by the long boiling required to fix the yellow and the red.

In the same manner are dyed all the shades of olive, the proportions varying with the colour required; the amount of mordant (alum) and acid employed, must diminish with the number of operations that have been conducted without emptying the dying vessel.

In dying the red shades of brown, for which camwood is used, a different process is employed, the insoluble combination formed between its colouring matter and the base of alum, prevents their being employed together.

For 90 lbs. of worsted goods in fresh water, dyed in a leaden vessel containing 300 gallons of water, added 15 lbs. of rasped camwood, 9 lbs. of rasped fustic, 12 measured ounces of sulphate of indigo, 5 lbs. of red argol, and 3 lbs. of sulphuric acid: after boiling the whole together a few minutes, added 20 gallons of cold water, and entered and boiled 1 hour; the goods had acquired a dull red brown colour—took up, added 6 lbs. of alum, and 3 measured ounces of sulphate of indigo; entered and again boiled one hour; the colour thus obtained, was a bright, full, red brown. In the same manner a similar shade of red brown, or others yellower, may be dyed in the same dying liquor, adding the alum after the red part of the colour has become fixed. After the above, a yellow brown approaching to a snuff colour, was dyed; for 100 lbs. of worsted goods added 2 lbs. of camwood, 10 lbs. of mull madder, 9 lbs. of rasped fustic, 3 lbs. of red argol, 14 measured ounces of sulphate of indigo, and 2 pounds of sulphuric acid; boiled one hour; took up, added 4 lbs. of alum, 1 lb. of sulphate of copper, (blue vitriol) 2 lbs. of rasped fustic, and 4 measured ounces of sulphate of indigo; entered, and boiled one hour. A small portion of sulphate of copper increases the brilliancy, and adds much to the intensity of the yellow browns.

The mode of dying olive and brown now described, has only been introduced to the dying establishments of this country since the last 20 years: it is called by dyers, the sour way. The same colours, possessing however little brilliancy, were dyed with cam-

wood, fustic, and logwood; the mordant employed was sulphate of iron (copperas.)

For 59 lbs. of a coarse woollen cloth called calmuc, a full olive brown: Dyed in an iron pan containing 400 gallons of water; added 20 lbs. of rasped fustic, 8 lbs. of rasped camwood, 6 lbs. of chipped logwood; boiled 1½ hour; took up, emptied the dying vessel half way, filled with fresh water, and added 2 lbs. of sulphate of iron; entered the cloths, turning quickly 10 minutes, raised gradually to ebullition, and boiled 10 minutes.

In the same manner may be dyed all the shades of copper, brown and olive. [*Annals of Philos.*

Leeds, December 20th, 1826.

Account of a new method of Drawing upon Stone. By M. Laurent, *Painter, Paris.*

Abstracted from the *Ann. de Chim.*

The ingenious process which we propose at present to describe, is taken from a report laid before the Institute by MM. Thenard & De Blainville.

Having taken the outline of the original design upon transparent paper, by tracing all the lines of the original with a dry point, more or less fine, the outline is then glued by its edges upon a board, and there is spread over it, with a piece of fine linen, a sufficiently hard paste, formed with lithographic ink, dissolved in essence of turpentine, which may be made in a spoon, exposed to the heat of a candle. The outline is then rubbed hard with a piece of clean linen, until the linen ceases to have a black tint. The outline is then transferred to the stone by means of a press. For this purpose, M. Laurent places in a vertical paper press, the stone, and the outline in contact, taking care to place above the latter, from twenty to twenty-five sheets of paper wetted in water, and adding in solution some calcined muriate of lime. Upon these last sheets is put a stone, and to prevent any injury, two large plates of paper about an inch thick, are interposed. The pressure is then applied for an hour, and upon separating the stones it will be found that the transparent outline adheres more or less to the stone. The paper is then removed by hot water, and the design is left upon the stone, which is now washed with cold water, till no trace of the transparent paper remains. There is no fear of the outline dissolving, as the base of the muriate of lime forms, with the oil of the soap, an insoluble soap, while the soda is combined with the hydrochloric acid, and composes a soluble salt, which has been carried away by the washing.

MM. Thenard & Blainville, who highly commend this process, propose the following lithographic ink as superior to any other, viz. soap, one-fourth; mutton suet, one-half; yellow wax, one part; mastic in tears, one-half; and as much lamp-black as is necessary. The whole being melted on a gentle fire, and well mixed, is reduced to

the consistency of a thick cream, by mixing with it equal parts of turpentine and lavender. The commissioners also recommend a thick and straight plank in place of the second stone, and they regard the process as a very valuable one in the arts. [*Brewster's Journal.*

On the subterranean sounds heard at Nakous, on the Red Sea.

Baron Humboldt informs us, on the authority of most credible witnesses, that subterranean sounds like those of an organ, are heard towards sunrise, by those who sleep upon the granite rocks, upon the banks of the Orinoco. Messrs. Jomard, Jollois, and Devilliers, three of the naturalists who accompanied Bonaparte to Egypt, heard at sunrise, in a granite monument placed at the centre of the spot on which the palace of Carnac stands, a noise like that of a string breaking.

Sounds of a nature analogous to these have been heard by Mr. Gray of University College, Oxford, at a place called Nakous, (which signifies a bell) at three leagues from Tor, on the Red Sea. This place which is covered with sand, and surrounded with low rocks in the form of an amphitheatre, presents a steep declivity towards the sea, from which it is half a mile distant. It has a height of about 300 feet, upon 80 feet of width. It has received the name of a bell, because it emits sounds, not as the statue of Memnon formerly did, at sunrise, but at every hour of the day and night, and at all seasons. The first time that Mr. Gray visited this place, he heard at the end of a quarter of an hour, a low continuous murmuring sound, beneath his feet, which gradually changed into pulsations as it became louder, so as to resemble the striking of a clock. In five minutes it became so strong as to detach the sand. The people of Tor declare that the camels are frightened and rendered furious by these sounds.

Anxious to discover the cause of this phenomenon, which no preceding traveller had mentioned, Mr Gray returned to the spot nex day, and remained an hour, to hear the sound, which was on that occasion heard much louder than before. As the sky was serene, and the air calm, he was satisfied that the sound could not be attributed to the introduction of the external air, and in addition to this, he could not observe any crevices by which the external air could penetrate. The Arabs of the desert ascribe these sounds to a convent of monks preserved miraculously under ground, and they are of opinion that the sound is that of their bell. Others think that it arises from volcanic causes; and they found this opinion on the fact that the hot baths of Pharaoh are on the same coast.

M. Humboldt ascribes the sound in the granite rocks, to the difference of temperature between the external air, and the air of the narrow and deep crevices of the shelves of rocks. These crevices, he informs us, are often heated to 48° or 50° during the day, and the

temperature of their surface was often 39°, when that of the external air was only 28°. [*Edinburgh Journal of Science.*

Remarks by the Editor.—Without attempting to add any thing to the conjectures respecting the cause of the sounds mentioned in the above article, we think that the fact of their existence furnishes a very probable solution of the origin of the sounds emitted by the celebrated statue of Memnon in Egypt. There is, we think, a striking analogy in the nature of the sounds, as above described, and those which it is said were emitted by the statue, which we are told "had the wonderful property of uttering a melodious sound every day at sun rising, like that which is heard on the breaking of the string of a harp when it is wound up. This was effected by the rays of the sun when they fell upon it. At the setting of the sun, and at night, the sound was lugubrious."

The probability that a place would be selected for the erection of such a statue, where such sounds were naturally produced, is so great as not to require insisting upon; and, in the absence of any certain mode of explaining the phenomenon, it removes the difficulties which have presented themselves in accounting for the sounds by the action of the solar ray on any mechanism contained in a statue of stone.

Mr. Steart's process in manufacturing the Lino-stereo Tablets.

The extra stout drawing-papers, or card boards, as they are usually denominated, are always made by pasting several sheets of paper together, in the manner of a common pasteboard, and afterwards bringing them to a smooth face by pressing and rolling. The pasting is a dirty operation, and the occasion of many defects, some of which are fatal to the degree of perfection and nicety required in a good drawing-board. Another great defect is, that the far greater part of the drawing and writing papers now in use in this country. are of a hollow or spongy texture; this arises from their being made of an indiscriminate mixture of linen and cotton; the greater elasticity of the latter, preventing its fibres from closely uniting with those of the flax; the consequence is, an irregular surface, and a porous spongy substance, very different from that which an adherence to the good old-fashioned practice of using fine linen rags only, in the manufacture of superior papers, would produce.

The lino-stereo tablet is entirely free from these objections, for the following reasons:—first, it is not composed of several sheets pasted together, but is moulded from the pulp of any required thickness, in one entire mass; thus the risk of pasting is avoided, and no separation of the component parts can possibly take place, though wetted ever so often: secondly, instead of being composed of linen and cotton, it is wholly and solely manufactured from the best and purest white linen rags, most carefully selected; and, consequently,

without the aid of the chloride of lime, or any bleaching process whatever.

The process.—In selecting the raw materials for the manufacture of the lino-tablets, great care is taken to preserve the *best and purest white linen* rags only, rejecting all muslins, calicoes, and every other article made of *cotton*. The linen rags are then carefully sorted, overlooked, and cleaned, washed and beaten into pulp in the usual manner practised by paper-makers of the first class.

The pulp being ready, and diluted in the vat with the proper proportion of pure water, the workman, dipping his mould first into the vat, takes it up, filled with pulp to the top of the deckle; and holding it horizontally, and gently shaking it, causes the water to subside, leaving the pulp very evenly set upon the face of the mould; having rested it for a moment or two in the bridge of the vat, the compresser with its face downwards, is now carefully laid upon the sheet or tablet, and both together placed in a small press close at hand, where it is submitted to a very gentle pressure, in order to exclude a great proportion of the water remaining in the sheet; it is then withdrawn, the compresser and the deckle are both taken off, and another workman couches it, by very dexterously turning the mould upside down, and pressing it pretty hard with his hands on one of the fine felts previously laid upon a very level pressing plank, by which means the tablet is left on the felt. The mould is then returned to the vatman, who repeats the process as before. The coucher, in the mean time, lays another felt upon the sheet or tablet just couched, whereon the second sheet is to be laid in the same manner; and so on, until all the felts are occupied; over which another level plank is placed, and the whole drawn away, on a small rail road wagon, to the great press, where it undergoes a pretty severe pressure.

The tablets will now be found to have sufficient adhesion to bear handling with care, and are separated from the felts, and placed one upon another, so as to form the packs: these packs are to be submitted again to the action of the press, until more water is expelled; then are parted sheet by sheet, pressed and parted again; and this is repeated as often as necessary, taking care to increase the pressure every operation, until the face of the tablets is sufficiently smooth: they are then carefully dried, sized, picked, sorted, &c.; carried to the rolling mill, and several times passed between the polished cylinders, to give them the last finish.

The above is the process for the plain or white tablets. In making the tinted tablets, the following additional particulars are to be attended to:—

The rags are cleansed, washed, and beaten into half stuff, in the usual way; the water being drained off, the pulp is put into a vat with a solution, in water, of acetate of alumine, or sulphate of iron, as a mordant or ground to fix the colour intended to be made; the whole is well incorporated, and suffered to remain for half an hour or more, when the colouring tincture, previously prepared, is added; after which, the whole being returned to the engines, is beaten into fine pulp, and then wrought into fine tablets.

The dying materials chiefly made use of by Mr. Steart, are, mangrove bark, quercitron bark, best blue Aleppo galls, sulphate of iron, and acetate of alumine. A due combination of these materials produces a great variety of drabs, grays, sand-colours, &c.

[*Abrid. Tran. Soc. Arts.*

On Etching and Dying Figures on Ivory, at one operation.

By Mr. J. Cathery.

From the Transactions of the Society for the encouragement of Arts, Manufactures and Commerce.

The usual mode of ornamenting ivory in black, is to engrave the pattern or design, and then to fill up the cavities thus produced, with hard black varnish. The demand for engraved ivory in ornamented inlaying, and for other purposes, is considerable, although the price paid for it is not such as to encourage artists of much ability, to devote themselves to this work, which consequently is trivial in design and coarse in execution. Mr. Cathery's improvement consists in covering the ivory with engraver's varnish, and drawing the design with an etching needle; he then pours on a menstruum composed of one hundred and twenty grains of fine silver, dissolved in one ounce measure of nitric acid, and then diluted with one quart of pure distilled water. After half an hour, more or less, according to the required depth of tint, the liquor is to be poured off, and the surface is to be washed with distilled water, and dried with blotting paper; it is then to be exposed to the light for an hour, after which the varnish may be removed by means of oil of turpentine. The design will now appear permanently impressed on the ivory, and of a black or blackish brown colour, which will come to its full tint after exposure, for a day or two, to the light.

The property which nitrate of silver possesses, of giving a permanent dark stain, to ivory and many other substances, has been long known; but Mr. Cathery has the merit of having advantageously applied it in a department of art in which it is likely to be of considerable service, by improving the quality of the ornament, and at the same time of diminishing the cost. Varieties of colour may also be given by substituting the salts of gold, platina, copper, &c. for the solution of silver.

Improvement in the manufacture of Magnetic Needles.

By Prof. Amos Eaton.

TO PROF. SILLIMAN.

Several years of the early part of my life were devoted to an extensive land agency, among the western and northern spurs of the Catskill mountains. During this period, I ran most of the outlines of two hundred thousand acres, besides four turnpike roads across

this Alpine district. The difficulties to which I was almost daily subjected, by the irregularity of the magnetic needle, were often very embarrassing. The old surveyors of that time assured me, that these fits, as they denominated those irregularities, were produced by the action of magnetic ores, which they believed abounded in this mountainous district. At one time I entertained the opinion, that I had collected facts sufficient to demonstrate, that while snow was melting away, these fits were the most frequent.

But on comparing different compasses, I found that they frequently varied, not only from the common direction of the magnetic needle, but from each other. For example, when set in some directions, one compass would vary, while other compasses would vary when set in different directions, and would not vary when set in the same directions. On extensive alluvial plains, where we could not suspect the presence of extensive ore-beds, all these difficulties occurred with equal force. And what appeared to be a still greater mystery, on changing needles, the variation seemed to be governed by the compass, not by the needle.

After considering every proposed hypothesis, and trying every proposed remedy, I abandoned the subject, as totally inexplicable; and contented myself with correcting these aberrations by ranging back-flags and using two compasses.

While exercising the students of Rensselaer school in land-surveying, at the last summer term, the same difficulties revived the same enquiries. In a conversation with an ingenious artist, Mr. Julius Hanks of Troy, I learned that his best compasses had in some instances, been subject to those fits of aberration. He showed me a compass of most elegant and accurate workmanship, with a nonius and double levels, which had been returned by the purchaser on account of the frequency of those fits. I carried this compass to the school with a determination to search out if possible, the cause of its frequent fits. By applying delicately suspended needles, which might be called a suit of magnetrometers, I found a point in the limb, which attracted a fine needle at the distance of six tenths of an inch. This point, caused the needle belonging to the compass, to deviate at the distance of half an inch on each side; beyond that limit it was not affected. Consequently, when the course to be taken, brought the needle within that limit, it would deviate, and point accurately in all other directions. Any practising surveyor will readily perceive, that in tracing the lines around a field, the needle might come within this limit several times, or it might not fall within it in running a dozen fields. Hence the supposed irregularity of the fits.

My conclusions from these experiments were, that a scale from a screw-cutter or a punch, or a tooth from a file, &c. too minute for the eye, might have been lodged in that particular point. On consulting Mr. Hanks, he said this might frequently happen, and it was not improbable that all those fits complained of by surveyors, might be traced to the same cause; inasmuch as all compass cards and graduated circles were wrought with very fine steel instruments. To illus-

trate the subject, I took out the screws from the under side of the card, and inserted the point of the finest sewing needle, less than the twentieth of an inch in length; whereby I actually produced four additional points of disturbance.

To obviate the difficulty, Mr. Hanks cut off seven tenths of an inch from each pole of the needle, ground the poles to very sharp points, and tipped them with brass caps, extending to the original length of the needle. This measure, by withdrawing the magnetic poles from the sphere of attraction, proved a perfect remedy. Mr. Hanks presented the same compass to the school, where it has been used almost daily for two months; and it is one of the most perfect instruments that I have ever used. It has no more fits, and is totally undisturbed by magnetic ores, real or imaginary. Mr. Hanks has since corrected a theodolite in the same way, which had been thrown aside as useless for several years. If the disturbing steel scale is in the card near the graduated circle, Mr. H. proposes lengthening the pivot and raising the circle by introducing an additional circle beneath the graduated one. But he has not made this experiment; and it is probable no such case will ever occur. For if it were near the pivot, it would not disturb the needle; and so little work is required in the card with slender instruments, that scales will not often be left in that part.

Another important advantage which will attend tipping needles with silver, brass, &c. is that of preserving the points from rust. It has been demonstrated by conclusive experiments, that magnetism resembles electricity in acting most powerfully from the sharpest points. Hence the absurdity of needles made of square bars. Hence, also, the utility of preserving the finely sharpened points by tips. I will add, that, of all forms of needles which I have used, the flat kinds are best, which are wide in the middle, and of a true taper to the points.

Yours respectfully,

AMOS EATON.

Rensselaer School, Troy, N. Y. Nov. 1826.

[*Silliman's Journal.*

CINCINNATI IN 1826.

We have just received a very interesting pamphlet of 100 pages, under the above title, written by B. Drake, and E. Mansfield, Esqs. of that place. The facts which it details have been collected with great industry, are skilfully arranged, and well narrated. The 7th and 8th chapters, which present a view of the population and manufactures of Cincinnati, we now present to our readers, and shall prepare for our next number, a general abstract of such other portions of the work, as may come most directly within the scope of our pages.

Population in December, 1826.

		First Ward.	Second Ward.	Third Ward.	Fourth Ward.	Total.	
Males,	Over 21,	970	1591	739	833	4133	7990
	Under 21,	983	1634	535	705	3857	
Females,	Over 18,	935	1636	613	761	3945	7550
	Under 18,	855	1583	501	666	3605	
	Blacks,	341	55	117	177	690	
	Total	4084	6499	2505	3142	16230*	

The average number of persons to a building, is six and a half. The actual density of *habitation* is much greater, from the fact, that a large portion of the buildings is occupied as stores, ware-houses, &c. &c.

There are within the city, at this time, about 28 Clergymen, 34 Attornies and Counsellors at Law, and 35 Physicians. It is estimated, that 800 persons are employed in Trade and Mercantile pursuits; 500 in Navigation; and about 3000 in Manufactures.

Comparative Population.

The following table is submitted, that the progressive increase of Cincinnati may be fairly exhibited, and the means furnished for comparing its advancement and prospects, with those of the most flourishing towns in the United States.

The first settlement of Cincinnati, was in 1788. The population did not increase, however, with any rapidity, till 1805, when it had scarcely attained the importance of a large village. A considerable number of emigrants then came out from Baltimore, and other eastern places; and from that time to the present, its growth and consequent prosperity have been remarkable, even in this astonishing age and country.

In 1810, the population was 2,320—1813, 4,000—1819, 10,283—1824, 12,016—1826, 16,230.

From this, it appears that the *ratio* of increase from 1810 to 1813, was 560 per annum, or 24 per cent.; from 1813 to 1819, 1043 per annum, or 26 per cent.; from 1819 to 1825, 364 per annum, or 3½ per cent.; from 1824 to 1826, 2107 per annum, or 17 per cent. The *ratio* of increase, *decreases* every where, as it respects population, with the *actual increase;* hence, though a new village may double in a single year, a large city, in its highest state of prosperity, scarcely attains an addition of 5 per cent. The operation of this principle being considered, the growth of this place, during the last two years, has been greater than that of any former period.

The relative population of several towns nearest in size to Cincinnati may be seen from the following table.

* The number of inhabitants, as here stated, may appear to those who have not attentively marked the progress of Cincinnati, as too *great*. The authors, with a view to accuracy on this important topic, made the enumeration in person. They feel confident, therefore, that the actual number in this city *exceeds* that given in the above table.

Providence.		Albany.		Pittsburgh & Liberties.	
In 1800,	7,614.	In 1791,	6,021.	In 1810,	4,768.
1810,	10,071.	1810,	9,356.	1820,	7,243.
1820,	11,767.	1820,	12,650.	1826,	11,226.
1825,	16,000..	1825,	15,500.		

Richmond.		Louisville.		New-Orleans.	
In 1800,	5,537.	In 1820,	4,012.	In 1802,	10,000.
1810,	9,755.	1826,	7,200.	1810,	17,242.
1820,	12,046.			1820,	27,176.

Manufactures.

The Artizans and Manufacturers of Cincinnati, who may be said to constitute the bone and sinew of the community, and upon whom the permanent prosperity of our city so materially depends, considered as a body, may be characterized as frugal, ingenious, and enterprising.

The number of our manufacturing establishments has greatly increased within the last two years, and the amount of productive industry for 1826, as will appear from the following statements, although not so great as could be wished, is by no means inconsiderable. The general prosperity of these establishments is beginning to attract the attention of capitalists, and is likely to augment their number. Indeed the Mechanics and Manufacturers of Cincinnati are decidedly the most *prosperous* class of citizens; and were the enterprise and capital of some of our merchants, embarked in similar pursuits, they would profit by the exchange. In this department, there is no danger, as in commercial pursuits, of running into excess. The region of country, which extended and successful manufacturing establishments will make tributary to our city, like the amount of manufactured goods required by its wants, is almost unbounded. Our Steam Boats may already be found upon all the navigable streams of the Mississippi valley: and our Steam Engines, Castings, Cabinet Furniture, Chairs, Hats, &c. &c. are sent to Kentucky, Alabama, Louisiana, Mississippi, Illinois, and Indiana, where they are sought after and admired, not less for their beauty, than their more substantial qualities. The inducements and peculiar facilities for our becoming a manufacturing people in this city, will be more fully discussed in a subsequent chapter of this book.

The following items, in regard to the manufactures of Cincinnati for 1826, have been collected with no small degree of labour, and with an earnest desire of having them as conformable to correctness as the nature of the case will permit. The following brief notices of some of the more prominent manufacturing establishments, will not, it is hoped, be deemed unimportant.

The Cincinnati Steam Mill, stands on Front between Ludlow street and Broadway. It is a substantial stone building, based upon the limestone rocks of the river, 62 by 87 feet, eight stories high, on the end next to the river, and measuring 110 feet from the base to the top of the roof. It has 24 doors and 90 windows. It required in its construction 6,620 perches of stone; 90,000 bricks; 14,000 bushels of

lime; and 81,200 cubic feet of timber. With the exception of the walls, this immense building was entirely consumed by fire in 1823. It has since been rebuilt, and is now in operation. It contains a manufactory of flour, a distillery, fulling mill, &c. The machinery is driven by a steam engine of 70 horse power. The establishment is capable of manufacturing 20,000 barrels of flour, 500 barrels of whiskey, and of fulling 1,000 pieces of cloth, annually.

Steam Mill for Sawing Stone. This establishment has just been made in the western part of the city, between Front and Columbia streets, and is owned by Mr. Alvin Washburn. The main building is 32 by 50 feet, 3 stories high, with one wing 20 by 40 feet, and is built of wood. It has a steam engine of 18 horse power. The first story is occupied with the machinery for sawing *free stone*. From the experiments already made, the proprietor feels confident of being enabled to saw 120,000 feet of stone per annum; and upon such terms as to make a signal reduction in the price of that important and beautiful material for building.

The second story contains machinery, driven by the same power, ingeniously contrived for the manufacture of tubs, buckets, and kegs, out of solid logs. About 30,000 of these will be produced annually.

In the third story the manufacture of *shoe trees* is carried on, the machinery for which, is also propelled by the same power. About 50 *lasts* per day can be made, requiring the labour of but four hands.

The Phœnix Foundry, owned and carried on by C. Tatem & Sons, is situated west of Walnut Street, between Third and Fourth. It gives employment to 18 hands; and about 175 tons of pig iron are annually manufactured into various kinds of machinery, such as steam engines, mill castings, &c. &c. The establishment consumes annually, about 7,000 bushels of pit coal.

The Franklin Foundry, is situated at the corner of Fifth Street and Broadway. It employs 10 hands, and manufactures annually, into the various kinds of castings, about 100 tons of pig iron. It is owned by the Messrs. M'Cormicks.

The Eagle Foundry, owned by Josiah Hawkins, is situated on the south side of Fourth Street, between Main and Walnut. It employs 14 hands, and uses 150 tons of pig iron per annum; besides about 5 tons of bar iron, a considerable portion of which is manufactured into ploughs. The establishment consumes annually about 4,000 bushels of pit coal.

Tift's Steam Engine and Finishing Establishment, employs between 30 and 40 hands. The business is carried on in a new frame building, of large dimensions, situated on Columbia Street, east of Broadway. The upper apartments of the building are intended for the reception of an extensive cotton spinning establishment, which Mr. Tift, with his characteristic enterprize, is now forming.

R. C. Green's Steam Engine Establishment, which is similar to that of Mr. Tift, is situated on Front Street, just below Deer-creek Bridge.

Goodloe & Harkness' Copper Foundry, Cotton Spinning, and Steam Engine Factory, stands at the corner of Broadway and Con-

gress Street. It employs about 50 hands. The cotton spinning department contains about 336 spindles, which produce about 600 lbs. of cotton yarn per week, or 31,000 pounds per annum.

The Ætna Foundry, owned by Street and White, is situated on Front street, below Deer-creek Bridge. It employs about 12 hands, and manufactures 220 tons of castings per annum.

Kirk's Steam Engine and Finishing Establishment, is situated on Columbia street, east of Broadway. It employs about 15 hands.

Shield's Engine Finishing Establishment, is situated in a stone building on Sycamore, between Front and Columbia streets. It employs about 30 hands.

Allen & Co.'s Chemical Laboratory, which has recently been commenced, is situated just above Deer-creek Bridge. It embraces the manufacture of Alum, Blue Vitriol, Copperas, Nitric and Sulphuric Acid, and other Chemical preparations. It will make from one to two tons of Alum per week. The Alum-earth is obtained from the hills of the Ohio river, near the mouth of the Scioto, where there are vast beds of it.

Powder Mill. An extensive and well planned establishment for the manufacture of Powder, has been made within the present year, by some gentlemen of this city, immediately below the mouth of Mill-creek. The machinery is driven by a Steam Engine, so arranged as to prevent any danger from fire. This is the only establishment of the kind within the state, and from the facilities of obtaining at this place, the raw materials, used in the manufacture of powder, it will no doubt be found a profitable business.

The Phœnix Paper Mill. During the past summer, a fine establishment for the manufacture of paper was erected under the superintendence of the Messrs. Grahams, on the river bank, in the western part of the city. When about to go into operation, in the month of December, it was entirely consumed by fire. The owners of it are now erecting upon its ruins another, to be called the Phœnix Paper Mill, which is 132 by 36 feet, exclusive of the wings. Its machinery will be worked by a substantial steam engine, and probably go into operation by the first of June.

The Cincinnati Steam Paper Mill, owned by Messrs. Phillips and Spear, is on the bank of the river, in the western part of the city. The building is 140 by 34 feet. The machinery is driven by a steam engine. The establishment employs about 40 hands, and produces annually a large quantity of excellent paper.

The Woollen Factory, erected several years since, by the Cincinnati Manufacturing Company, stands on the river bank, above the mouth of Deer-creek. The main building is 150 feet long, and between 20 and 37 feet wide. It is calculated for the manufacture of woollen goods, white and red lead, linseed oil, &c. The operations of this establishment are, for the present, suspended.

The Sugar Refinery, is a large brick building, erected for the purpose, situated north of Third, and between Ludlow street and Broadway. When in full operation, it is capable of refining about 180,000

pounds per annum. There has been but a small amount of sugar refined in it during the present year.

The White Lead Factory, owned by T. Clayland & Co. and the only one in the city, is situated at the east end of Fifth street. It employs three hands, and will hereafter manufacture about 1,500 kegs of white lead per annum. The principal supply, however, of this article is drawn from Pittsburgh,—a fact worth the attention of capitalists. The metal from which this article is produced, is carried past our city, and against the current of the stream, 460 miles to Pittsburgh; and over land, 84 miles to Lexington: at these places it is converted into white lead, and returned to Cincinnati. In either case, the necessary expenses of transportation, would be a handsome profit for the manufacturer in this city.

The Messrs. Wells' Type Foundry and Printers' Warehouse, is situated on Walnut street, between Third and Fourth, where they manufacture, in a superior manner, all kinds of type, presses, chases, composing sticks, proof gallies, brass rule, &c. &c., at the eastern prices. They employ about 23 hands. This valuable establishment has entirely superseded the importation of type and other printing materials, from the eastern states.

There are in the city, three permanent Boat Yards for the construction of steam-boats, besides one or two others, in which they are occasionally built. The regular establishments are owned by Gordon, Parsons, and the Messrs. Weeks. During 1826, there were about 200 hands employed in this business. The reputation of these Yards, is superior to that of any on the western waters.

The manufacture of Hats in this city, is carried on to a very considerable extent, many of which are exported. Our Hatters not only select the best furs that are offered in the west, but also make importations from the eastern states. Some of the most substantial, and elegantly finished hats that we have ever seen, were from the Messrs. J. Coombs' and A. W. Patterson's establishments in this city.

The Cabinet Furniture and Chairs, manufactured in Cincinnati, are of the most beautiful kind, and will compare with those produced in any part of the Union. Considerable quantities of these articles are exported to the states west and south of Cincinnati.

There are nine Printing Establishments in this city, which print about 7,200 newspapers per week, or 175,000 per annum. There have been printed at these offices, within the year 1826,—61,000 Almanacks, 55,000 Spelling Books, 30,000 Primers, 3,000 Bible News, 3,000 American Preceptors, 3,000 American Readers, 3,000 Introduction to the English Reader, 500 Hammond's Ohio Reports, 500 Symmes' Theory, 3,000 Kirkham's Grammar, 1,000 Vine-Dressers' Guide, 14,000 Pamphlets, 5,000 Table Arithmetics, 2,000 Murray's Grammar, 1,500 Family Physician, 14,200 Testaments, Hymn, and Music Books.

There is no Umbrella Factory in this city. Of the success of an establishment of this kind, there can be no doubt.

The value of Manufactured Articles, or in other words the produc-

tive industry of the Artizans and Mechanics of Cincinnati, for the year 1826, will appear from the following table.

Five Steam Engine and Finishing Establishments, employing 126 hands; value of manufactured articles,	$134,000
Four Iron Foundries, 54 hands,	59,400
Eleven Soap and Candle Factories, 48 hands; (451,000 pounds of soap, and 332,000 pounds of candles,)	51,500
Ten Tanneries and Currying Shops, 66 hands,	76,500
Thirteen Cabinet Furniture Shops, 104 hands,	67,950
Four Rope Walks, 31 hands,	23,000
Two Breweries, 18 hands,	20,900
Seven Hatters' Shops, 95 hands,	123,200
Twenty-nine Boot and Shoe Shops, 257 hands,	88,550
Two Wall Paper Factories, 9 hands,	8,400
Ten Saddlers and Trunk Makers, 66 hands,	41,900
Three Tobacco and Snuff Factories, 28 hands,	21,200
One Brass and Bell Foundry, 4 hands,	3,500
Nine Tin and Coppersmiths' shops, 39 hands,	48,800
One Oil Mill, 7 hands,	11,700
Two Woolcarding and Fulling Mills, 11 hands,	6,500
Six Chair Factories, 38 hands,	21,973
Three Turners in Wood, 9 hands,	2,925
Eleven Coopers' Shops, 48 hands,	29,700
One Type Foundry, 23 hands,	20,000
One Clock Factory, 18 hands,	20,000
Three Plough Factories, 11 hands,	10,475
Eight Carriage and Wagon Factories, 37 hands,	26,280
Two potteries, 8 hands,	4,500
Two Woollen and Cotton Factories, 6 hands,	4,100
Two Boot and Shoe Tree Factories, 5 hands,	1,100
Two Plane Stock, Bit, and Screw Factories, 7 hands,	11,145
Two Comb Factories, 6 hands,	1,600
One Looking-glass and Picture Frame Factory, 7 hands,	2,000
One Sieve Factory, 3 hands,	3,400
One Chemical Laboratory,	2,400
Six Book Binderies, 14 hands,	11,971
Seven Silversmiths' Shops, 17 hands	8,600
Ten Bakeries, 28 hands,	29,400
One Paper Mill, 40 hands,	22,000
Twenty-one Smiths' Shops, 92 hands,	48,000
Five hundred Carpenters,	165,000
Thirty Painters,	13,900
Thirty-five Tailors' and Clothiers' Shops, employing 132 men, 467 women,	172,815
Fourteen Brick Yards, 210 hands, (10,000,000 of Bricks,)	25,000
One Cotton Spinning and Brass Foundry, 21 hands,	22,000
One Matrass Factory, 3 hands,	1,000
One White Lead Factory, 3 hands	3,672
Four Stone Cutting Factories, 18 hands,	11,100
Three Steam-boat Yards, 200 hands,	105,000

Nine Printing Establishments, 58 hands,	52,000
One hundred and Ten Brick-layers, Stone-masons, and Plasterers,	37,650
One Distillery, 2 hands,	4,300
	1,682,000

From the following establishments and artizans no returns have been received: 1 Sugar Refinery; 3 Copperplate Engravers; 3 Portrait and 1 Miniature Painters; 1 Cotton and Wool Card Factory; 1 Steam Saw Mill; 4 Carpet and Stocking Weavers; 2 Steam Flour Mills; 1 Powder Factory; 2 Crockery and Stone-ware Factories; 1 Carver in Wood; 40 Milliners-shops; 2 Brush Makers; 1 Wheat Fan Factory; 1 Pump and Block Maker; 1 Saddle-tree Maker; 4 Chemical Laboratories; 1 Sash Maker; 2 Blacksmiths; 2 Piano Factories; 1 Organ Builder; 5 Shoe-makers; 2 Tailors; 1 Distillery; 2 Upholsterers; 1 Cutler; 9 Confectionaries; 2 Gun-smiths; 3 Lime Kilns; 2 Bakeries.

From the best data which can be obtained, the value of the articles produced in these Factories and Shops is not less than	100,000
In addition to the above may be added Pugh and Teater's Glass Works, at Moscow; Duval's Paper Mills, at Mill Grove; and 3 Cotton Spinning Factories, all of which are owned by citizens of Cincinnati, and the manufactured articles from which, are sold in this city. The value of the products from these establishments may be safely estimated at	68,000
	$1,850,000

Observations upon the present Mode of Paving, in London, with a Plan for its Improvement.

Having observed that the present system of paving works badly, and imagining that it admits of easy and effectual remedy, by which economy and general convenience might be durably attained, I would first point out the following as its chief

Imperfections.—The *nature* and *state* of the soil in which the paving stones are placed.

The wedge-like form of the stones.

The great distances between them at their lower surface.

The frequent disturbance of them for the repair of pipes and sewers.

On a comparison of these imperfections I would observe, that while the present soil is continued as a substratum so readily softened by water, and dug up loosely as though to facilitate the stones driv-

ing into it at irregular depths, neither the biangular, the block, nor any other pavement, ancient or modern, will prevent its rapidly acquiring an uneven and muddy surface, as a permanent support can only be obtained either perpendicularly, by a substratum nearly unyielding, or diagonally by buttresses; the latter being impracticable from the expense it would involve, the cellars it would force in, and the old houses it would tumble over our heads, leaves the alternative of obtaining a good substratum of road on which to place the pavement; which I propose to obtain by the following

Plan.—Let the stones be for the present removed. The soil, to the depth of eight inches, sifted, the fine portion sent off altogether, the coarse retained for the road; but, before spreading, the sub-soil should be dug and raked, to bring the coarse material to the surface, which should be covered by that obtained from screening, and a surface added of about three inches of such of the present pavement, properly broken up, as are totally unfit for tolerably good pavement. When sufficiently worn, I would add three inches of the same material; so far it will be seen I propose to form a Macadamized road, on which, as soon as it had acquired by raking and wear an uniform and solid surface, I would, without scraping it, lay paving stones of equal depth and width, and as square as they could be obtained, consistent with economy, introducing the large end downwards where there was any approach to a wedge-like form, always remembering to place the lower surfaces of the stones in close contact, both at sides and ends, and that no two joints should follow in continuity. I would then ram into the interstices such thin chippings of granite as might fit them, and wash in scrapings from a granite road, or any cheap body of more cementing properties, and which would be as little effected by changes of temperature. This plan would require for the sub-road the bulk of the present pavement, leaving a few of those most uniform in depth, and least wedge-like in form, to be introduced, the large end downwards, in a length of street unmixed with the new pavement, yet treated in the same manner.

Pipes should be laid as close to the curb as possible, where the traffic is least; and whenever the ground is filled in after repair of pipes or sewers, it should be well rammed throughout its depth; and no soil that would be readily acted on by water should be allowed within eighteen inches of the surface.

It will be allowed that a wedge, either of stone or wood, is adapted to drive into soft ground; and though a pavior may force it pretty hard, it will not stop there; for if the maximum of force from a pavior's rammer be equivalent to 5 cwt., (a large estimate) it must be expected that a wheel, conveying a weight of a ton and a half, must needs drive further; and more especially where, by holes already formed, the weight and impetus will frequently amount to more than two tons from a single wheel.

Common earth and rubbish readily mix with water; thus mud must be formed under the pavement in wet weather, which, passing off through the needlessly wide interstices, occasions a rapid accu-

mulation of mud on the surface, and makes room for the descending stones, some of which, being on softer ground, or more wedge-like in form, or smaller, or placed originally lower than those next to them, sink more; a reservoir is thus formed for the rain, which sinking into the ground and forming mud, the wheels which pass with increased force into such holes enlarge and deepen them. The deeper the hole, the greater the force of the descending wheel, and the longer the continuance of the reservoir to mix with the earth; so that the evil increases in a two-fold ratio.

This plan would, I think, realize the following

Advantages.—The sub-soil or road would no longer yield mud, nor allow the wider and flatter surfaces of the stones to pass into its hard and level surface, and form holes in the pavement.

Horses and carriages would all be adequate to more work, with less expenditure of strength and soundness. Indeed, the great mass of suffering endured by the enflamed joints of, perhaps, every hackney coach horse, should of itself induce humane persons to promote some reasonable plan to remove the cause of it; and the quantum of suffering borne by other carriage and saddle horses must be very considerable.

The inconvenience and danger to riders and their horses would be much diminished.

Commerce, and the various objects of passengers of all descriptions, would seldom be interrupted by the mending of pavements.

Even the footpaths, freed from the abundant supply of mud from the carriage-road, would be much cleaner.

The sewers would, probably, never need cleaning, and being permanently more free from mud, would contribute more even than they now do to the health of the inhabitants.

I by no means think that this plan would produce a perfect road; but I believe that it would be more permanently level, durable, clean, and economical, than has ever been seen in any much-worn street of this metropolis.

I have calculated that permanently-good paving in London, Westminster, and Southwark, would save, in the wear of horses and vehicles of all descriptions, not less than one hundred and forty thousand pounds per annum; besides that fewer horses, and somewhat lighter carriages, would be adequate to the work required. Should this become apparent, the interest of brewers, coach-masters, coal merchants, and the poor hackney-coachmen, would be materially served; and every humane person rejoice at the great reduction in the sufferings of the most noble of quadrupeds.

I wish also to suggest the following observations on the adaptation of Macadam's roads for the chief thoroughfares of this metropolis.

It would seem that for a road not extremely used, this plan is far preferable to any other yet introduced; but such is the rapid wear by pulverization, of granite and all other brittle substances, and so slowly do they yield to mere friction, that I apprehend where the road would wear ten inches in a year, the well-paved street would

not yield more than one fifth of an inch in the same period, after the first wear of the sharp edges of the stones, which with close joints would be very trifling.

A Macadamized road, if much used, requires such constant watering in dry weather to keep it together, and in wet, wears so rapidly, especially on the level streets, and those running east and west, thereby being shaded by the houses to the south, that a constant expense is entailed either way.

If any doubt the great difference in the destructive properties of pulverization and friction on brittle substances, it may be well to notice the patent illuminators for ships' decks, which last generally for many years unaltered, except by some scratches on their upper surface; yet were any one of them to be broken into twenty pieces, so as to render them, by their size and shape, liable to pulverization, there is not one of them but would be ground to powder by a thousandth part of what some of them have borne.

GEORGE KNIGHT.

Norway Wharf, Limehouse.

[*Journal Royal Institution.*

FOR THE FRANKLIN JOURNAL.

On Paper for Records, and other Legal Instruments of Writing.

THE subjoined letter from a distinguished member of the Philadelphia bar, to Peter A. Browne, Esq., sufficiently explains the importance of the subject to which it refers. It was designed to call the attention of the Committee on premiums, of the Franklin Institute to a point of such general moment; the letter, however, was not received until that committee had completed the list of premiums for the present year, and it is probable that the desired object may be more effectually attained through the medium of the Journal, than by the offering of a premium. In the latter case, a paper maker might make a few reams which might merit the premium, without affording that supply which it is so desirable to obtain.

To us it appears that it would be the undoubted interest of one of our best paper makers to furnish a regular supply of paper made specially for the purpose of legal instruments of writing, of such a texture as would possess all the qualities desired. Its use would be extensive, as it would undoubtedly be adopted in the public offices, as well as by the members of the bar, and a price could readily be obtained, which would amply remunerate the maker.

The principal danger to be apprehended, is from the deterioration in quality, which we so generally witness in articles, after they have obtained possession of the market. Whenever the manufacturer concludes that something a little inferior will do *well enough*, he has taken that step which will eventually destroy public confidence, and consequently defeat his own object. There are, however, men of skill in the business, who know how to produce the article wanted, and whose characters stand sufficiently high to inspire confidence in

a pledge, that they would continue to furnish such paper, of a uniform quality. We have in the market, some beautiful paper for folding maps, uniting the qualities of a good surface, toughness, flexibility and body, with that lightness of texture which is desired for that purpose; and we apprehend that it is in the power of the same workmen to produce a thick paper of equal excellence.

We would gladly aid in the attainment of the object, by offering our journal as a medium of communication from manufacturers and others interested in the business.

Philadelphia, March 1*st*, 1827.

Dear Sir,—A knowledge of the interest you take in every thing connected with our domestic manufactures, induces me to call your attention to the writing paper used in this city for general purposes, but more especially to that used by the bar, and in the public offices. I have observed for a period of eighteen months past, that it was very difficult to obtain good writing paper of the manufacture of Pennsylvania; and that with a single exception, that of Mr. Amies, it was of inferior quality.

The effect of using inferior paper for legal instruments, records, &c. is well known to those whose pursuits often oblige them to sort, with great pains, the disjointed pieces of an important document, on which may depend the fortune of an individual; or who see a declaration requiring the assistance of wafers to hold it together, before the cause in which it is filed, can be reached and tried.

With a view to satisfy myself upon the subject, I have taken the pains to examine the dockets of the supreme court, and of the common pleas of this county, and have found the earlier records in good preservation, although some of them are nearly one hundred years old. The quality of the Dutch paper, upon which the earlier records are written, and that of the English paper, which was used at a more recent period, has enabled them to withstand the effect of time much better than I have reason to believe any of the qualities of paper, now manufactured in Pennsylvania, would be found to do. Indeed many of us may expect, if we reach the ordinary age allotted to man, to outlive the records we contribute to furnish, unless we adopt a more lasting material.

I am, however, not without hopes, that if the subject be brought before the Franklin Institute, the paper of Pennsylvania would in a short time rival Whatman's, or the celebrated Blauw paper. And I am very desirous to see what would be produced by the offer of a premium for the best quarto post writing paper, and of the best cap paper, prepared solely for instruments of a legal nature.

I need scarcely remind you, my dear sir, that the use of the same kind of paper by the profession, would much facilitate the performance of some of the duties in the public offices connected with the administration of justice—it being well known that the difference in size of the sheets, causes the clerks great trouble, and often occasions the loss of part of the record. With a view to prevent any difficulty of the kind, it is the regulation, as I am informed, of some of the public

offices at Washington, that no communications of a particular nature are to be received, unless written upon paper of a certain size. In England all law papers and documents, are upon the same kind of paper.

I shall feel much gratified, should you deem this subject of sufficient importance, to have the attention of the Institute called to it; for I do not remember to have seen, at the last exhibition, among the numerous and striking proofs of our progress in manufactures, a single specimen of writing paper.

I am, dear sir,
Very truly, yours, &c.
EDWARD D. INGRAHAM.

Peter A. Browne, Esq.

On removing the points of broken drills and taps from articles of silver or brass, and of spikes from brass cannon, &c.

TO THE EDITOR OF THE FRANKLIN JOURNAL.

SIR,—I was particularly pleased with your method of "dividing plates of hardened steel," in the last number of the Franklin Journal, and perhaps another instance of the advantage which the mechanic may derive from a knowledge of chemical science, may prove equally acceptable to your numerous readers of that class.

When doctor Hare's compound blow-pipe was first introduced, I constructed one. In drilling the silver nozle, the drill broke at the moment it was about perforating the end, and a piece of the drill, of about one eighth of an inch in length, remained in the hole. As I had succeeded in drilling the other hole, the accident was particularly mortifying. Being unwilling to destroy the nozle, on which I had bestowed considerable labour, it occurred to me to try whether diluted sulphuric acid (oil of vitriol) would not dissolve the broken part of the drill. For the experiment, I, at night, put the nozle into a wine glass, covered it with water, and added sulphuric acid by drops, until I perceived a succession of globules of gas arise from the hole, and left it until sun rise next morning, when I had the satisfaction to find the steel entirely dissolved, and with a fine pointed punch I finished the orifice of the nozle.

This winter, I had occasion to turn three brass balls, one inch in diameter, and which were tapped half an inch deep. As I am not a professional mechanic, I, from a deficiency of tools, often find it necessary to make one tool answer as many purposes as I can, and on the present occasion, finding I could center the tap, with which I screwed the balls, in a chuck, I undertook to turn them on that, as a substitute for an arbor. With care, two were finished; but with the last, I suffered the turning tool to catch one of the corners of the square part of the tap, and broke it off even with the circumference of the ball. As I had a pressing occasion for the ball, and had no other cast, I immediately put it in the bottom of a broken oil flask, covered it with water, and added about one sixth part of sulphuric

acid, (oil of vitriol,) and placed the capsule on a stove, with a handful of ashes interposed as a substitute for a sand bath: other business requiring my attention, I did not examine it until after three or four hours, when I found the tap entirely dissolved without the least injury to the threads of the screw.

I think it probable, that the above method would be found sufficient to unspike brass cannon, and thus supersede the necessity of remelting them, or of spoiling the touch-hole in the ordinary way of drilling. For this purpose, a flat bar of wood, three or four feet longer than the gun, would be required. At the distance of the touch-hole from the back of the chamber, place on the wooden bar, a lump of fat-lute; bees-wax, made soft by an admixture of oil; a cone of lead to enter the touch hole, or any other substance which would resist the action of sulphuric acid. By using the lower edge of the muzzle of the gun as a fulcrum, and depressing the projecting end of the bar, the lute would cover the touch-hole, or the cone enter the same, and render it sufficiently tight to prevent any liquid passing down. A cup, of wax, should then be raised around the touch-hole on the outside of the gun, of sufficient capacity to contain a pint, or more, of diluted sulphuric or muriatic acid, and if the experiment were made in a temperate atmosphere, I think the gun might be rendered serviceable without any other injury than it received from driving the spike.

H. W.

Observations upon Rail-roads. By E. Hazard, *Civil Engineer.*

TO THE EDITOR OF THE FRANKLIN JOURNAL.

Dear Sir,—When travelling upon some of the rail-roads in England, I noticed that the wheels did not appear to bear hard against the sides of the rails, even where there were short turns in the road. This led me to an examination of the cause, which, as I have not seen it mentioned in any publication on the subject, I will now state. The wheels of the carriage are wedged on the axletree at such a distance apart that there may be an inch play between the flanches of the wheels, and the rails. The journals, or round parts of the axletrees, are an inch longer than the brass boxes in which they work, so that the axletree may move an inch endwise, before the shoulders come in contact with the box which is attached to the wagon body. These two circumstances are sufficient to prevent the lateral friction, where the road is nearly straight; but, in addition to these, where the road winds considerably, the rail farthest from the centre of the curve is placed *higher* than the other, the middle of the curve being the highest point, and from that gradually descending both ways, till it becomes level with the other rail at each extremity of the curve. The consequence of this is, that the load, as the road bends, slides on the axletree towards the centre of the curve, and when the box comes in contact with the shoulder of the axle, assists the exterior rail in turning the wagon from the direct line; so that the rail in fact has only to throw the axle over, without any part of the load.

On the Hetton rail-way, they are *abandoning the locomotive engine.* The jarring occasioned by the wheels passing over the ends of the rails, although apparently trifling, is found to destroy the joints so fast, as to make it cheaper to maintain *stationary* engines at two miles distance from each other, with ropes extended between them, to draw the wagons. The buildings for some of the stationary engines were erected when I was there. The locomotive-engines on this road, were furnished with the pistons mentioned by Mr. Strickland, which were intended to operate as *springs* to prevent the jar; but, upon close inspection while the engine was travelling, I am convinced they did not move. Indeed, it appears to me, that if they did operate at all, it would be injuriously, since the connecting rods will always be carried by the crank pins to a given point, and if the boilers with the cylinders attached to them, were raised by the small pistons from the axletrees, the connecting rods would thereby be rendered too short to pass the dead-centres, which must infallibly derange some of the machinery.

On the Fawdon rail-way, the wagons were moved, in part, by stationary engines with a rope extended between them. The rope is placed in the jaws of a vice attached to the wagon, where it is secured, and alternately wound up on drums by the engines at its extremities; its length was that of double the distance between the engines. Where the rail-way crossed a public road, the rope was bent down by friction rollers, and carried under a plank bridge, to the other side of the road, where it again rose above ground. When the wagon comes to the public road, the boy who rides on it, releases the rope from the vice; the velocity of the wagon carries it over the road, and the boy again hooks up the rope into the vice, while the wagon continues its motion.

By declining the use of locomotive engines, a great proportion of the expense of the rail-way may be saved, since wagons carrying from one and a half to two tons, can be used with as good economy as those of larger burthen, and they would require a rail-way of only one-fifth the strength of those on which steam engines are to travel.

It does not appear to be decided whether cast or wrought iron rails, are to be preferred; the former are used on the Fawdon, the latter on the Stockton and Darlington rail-way, and at each they speak most favourably of the kind they have adopted. I saw some of each which were said to have been in use for a number of years; both appeared to wear equally well, the original surface being still visible in each. The length of the wrought iron rails was certainly objectionable, both on account of the *expansion and contraction* of the metal, and the difficulty of obtaining an *equal bearing on all the props;* only a small proportion of which, were in contact with the rails I examined. To remedy this, they propose, in future, to cut the rails in two, at each prop.

I am decidedly of opinion, that in this country a rail-way of wood, sheathed with iron, would be preferable to any other, and could be kept constantly in order at the least expense. The preparation of the ground to receive the rails would be the same in any case; the

labour in laying down the rails very nearly the same, but the *materials* would cost but about one-fifth as much as the iron rails and props. On the plan adopted in England, each prop rests on a detached stone, or, in many places, a block of old ship timber. These stones, or blocks, are of *irregular form and size*, and the cast iron prop is rarely placed on the *centre of bearing or bed* of the stone, or block; the consequence is, that the weight passing over them, *sinks* them unequally into the ground, and gives them a *rocking* motion, which requires the *constant* labour of ramming them up with a bar of iron, to bring the rails level, and parallel to each other. Severe frosts would also derange them by operating unequally on foundations of different textures. In the wooden rail-way, *sills, embracing both rails*, would be substituted for the stones and props, and the whole would form a *connected frame*, which would reduce the action of the loads to a perpendicular pressure, which can easily be sustained. The construction is so simple that any particular piece can be taken up and replaced, as it *decays*, with as little detention as *the stones* on the other plan can be put in order; and the interest of the difference of the cost, will defray the expense. The wear of the iron sheathing will be so trifling, that it may be considered nearly as a permanent fixture.

Should you deem the above remarks likely to throw any light on the subject of rail-ways, you are at liberty to make any use of them your may think proper.

Your obedient servant,
ERSKINE HAZARD.

Philad. March 27, 1827.

Method of restoring Wine that has been turned.

A METHOD has been in practice for some years, to restore wine that has been turned. The process consists in adding from half an ounce to two ounces of tartaric acid of the shops, to a hectolitre of wine, (about 26 galls.) according to its state of decomposition. The tartaric acid reproduces the tartar, disengages the carbonic acid, and, consequently, destroys the alkaline character given to the wine by the sub-carbonates.

The Agricultural Society of Bourges has frequently repeated this experiment; but it has not always succeeded. They, however, ascribe this uncertainty to the impossibility of determining the exact quantity for every case. [*Bull. de Sc. Tech.*

Colouring Matter of Wine.

IN an Italian publication called "Annals of Technology, Rural and Domestic Economy, Arts, Trades, &c." is a paper by a Dr. Lomeni, on the causes of the fading of the colour of wine made in closed vessels, with a description of a kind of bellows by which that

injurious effect may be obviated. Dr. Lomeni considers it an undeniable fact, that wine made in close vessels has less body, colour, and aroma, than wine made in the old method; but maintains, that by means of the motion produced in the wine by the apparatus which he has invented, the advantages of making wine in close, and making it in open vessels, may be united.

Brome, a new substance, supposed to be simple.

M. Balard, a chemist of Paris, has discovered a new substance in sea water, to which the name of *Brome* has been given. It exists in sea water in the form of hydro-bromic acid, combined, in the opinion of M. Balard, with magnesia. It is present, however, in very small quantities. It is obtained by adding chlorine to the bittern, which remains after the muriate of soda has been separated from sea-water by evaporation, an orange coloured tint is produced, and on heating the mixture to the boiling point, the red vapours of brome are expelled, which may be condensed by a freezing mixture.

At common temperatures brome is liquid; its colour by reflected light is blackish-red, but when light is transmitted through a thin stratum of it, the colour is hyacinth-red. In its properties it appears to be intermediate between chlorine and iodine; its odour resembles the former, is very disagreeable, and its taste powerful. It is highly destructive to animals; one drop of it, placed upon the back of a bird, having proved fatal.

In the elaborate memoir of M. Balard, he has given a detail of the habitudes of brome, in its relationship to other substances; this memoir was referred to a commission of the French Academy, consisting of MM. Vanquélin, Thenard, and Gay-Lussac, who speak in high terms of the merit of the memoir of M. Balard, and, although they do not think that he has proved that brome is an elementary substance, they yet deem it very probable.

Substance that inflames upon contact with water.

At Doulens, near Amiens, is a large manufactory for spinning cotton, which is lighted by oil-gas. This gas upon its return from the cast iron cylinder, filled with red hot coal, where it is formed, traverses a reservoir of oil, in which it deposits a white liquid matter, which can be taken away by means of a spigot, situated at the lower part of the reservoir. The workmen employed in this duty, having dropped some of it to the ground, upon water, it appeared to be all on fire. The proprietor of the factory, intends to send a bottle of this singular substance to M. Gay-Lussac, to have it chemically analyzed. [*Bull. Univ.*

Domestic Manufactures in Massachusetts.

Boston, March 15.

The exhibition of home manufactured articles in the chambers of New Market House, on Tuesday and Wednesday, was fully equal to the anticipations of our citizens. There was a great variety, and most of the articles were of a superior kind.—The broadcloths, cassimeres, flannels and sattinets were in great quantities. But there was not so large an amount of superfine broadcloths as in October last. Of cotton goods, sheetings, shirtings and printed calicoes, there was also an extensive assortment. Some of them very fine; and the colours and figures of the prints very good. Articles of glass ware and cabinet furniture were numerous; and some fine ware in imitation of China was offered.—There were likewise, great quantities of wool, leather and shoes. The sales, we understand, were generally made at fair prices—and the plan, thus favourably began, will probably be prosecuted on future occasions, with equal spirit, and enterprise.

Writing Pens.

The ancients were unacquainted with the fitness of quills for the purposes of writing. They chiefly employed tablets covered with wax, on which they engraved the characters with a metal style, and when they wrote with liquids on parchment, or on the paper then manufactured from the Egyptian papyrus, they made use of reeds. It has been supposed that quills were made use of for writing as early as the fifth century; but the conjecture rests merely on an anecdote of Theodoric, King of the Ostrogoths; who, being so illiterate, that he could not write even the initials of his name, was provided with a plate of gold, through which the letters were cut; and this being placed on the paper, when his signature was required, he traced the letters with a quill. The earliest certain account of the modern writing pens, dates no farther back than 636; and the next occurs towards the latter end of the same century, in a Latin sonnet to a Pen, composed by Adhelm, a Saxon author, and the first of his nation who wrote in that language. After that period, however, there are numerous proofs of their having been very generally known; but they were so far from having at once superseded the use of reeds, that persons well versed in manuscripts affirm, that the latter were commonly used in the 8th century. Reeds are still employed to write with by many of the eastern nations. We learn, from the voyages of Chardin, Tournefort, and others, that they are small hard canes, about the size of large swan-quills, which they cut and slit in the same manner that we do quills, except that they give them a much longer nib. Had the ancients been acquainted with the art of employing quills for writing they would probably have dedicated to Minerva, not the owl, but the goose.

LIST OF PATENTS IN ENGLAND,

Which passed the great seal in December, 1826.

To Thomas Machell, in the county of Middlesex, surgeon, for his invention of certain improvements on apparatus applicable to the burning of oil and other inflammable substances—Sealed 8th December.

To Robert Dickenson, in the county of Surrey, in consequence of a communication made to him by a certain foreigner residing abroad, he is in possession of an invention for the formation, coating and covering of vessels or packages, for containing, preserving, conveying, and transporting goods, and products, whether in liquid, or solid forms, and for other useful purposes—8th December.

To Charles Pearson the younger, of Greenwich, in the county of Kent, Esq.; Richard Witty, of Hanley, in the county of Stafford, engineer; and William Gillman, of Whitechapel, in the county of Middlesex, engineer, for their having invented a new or improved method or methods of applying heat to certain useful purposes—13th December.

To Charles Harsleben, Esq. in the county of Middlesex, for his invention of machinery for facilitating the working of mines, and for facilitating the extraction of diamonds and other precious stones, gold, silver, and other metals, from the ore, the earth, or the sand, which machinery is likewise applicable to other purposes—13th December.

NOTICES.

To admit of the Address, and Premiums of the Franklin Institute, without increasing the postage, we have omitted eight pages of other matter; the deficiency will be made up in the succeeding number.

The last number of Silliman's Journal contains a "Vindication of the Memorial on the upward force of fluids, by E. C. Genet." As this Vindication was written before the appearance of our remarks upon the Memorial, in our number for January, and is principally devoted to the notice in the Boston Journal of Science, we think that it would be premature to resume that subject. We may hereafter, when in a quixotish mood, again embark on board a *Hydronaut*, or accompany the flying fish *Æronaut*, into the upper regions of sublimated imagination.

The communication of C. P. upon the subject of the Chess Player, was not received in time for our last number; his remarks may be used at a future day.

An article upon Friction, intended for the present number, has been unavoidably postponed, but will appear in the next, when F. will see that he has not been forgotten.

FIRE ENGINE.

Merrick & Agnew, Makers.

Fig. 1. p 283

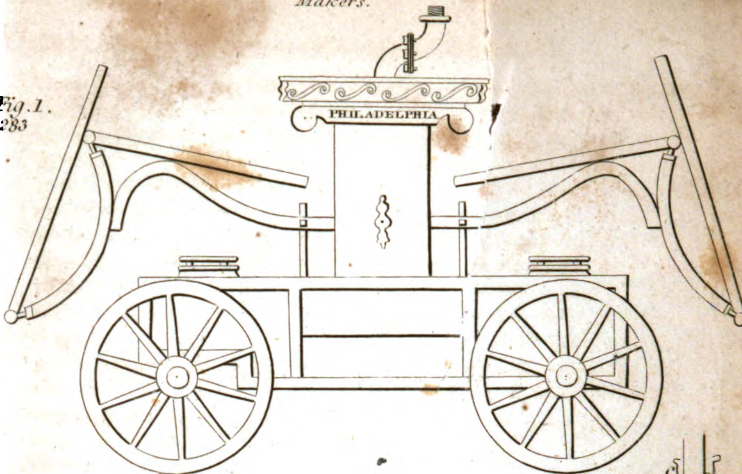


Fig. 2. p 283

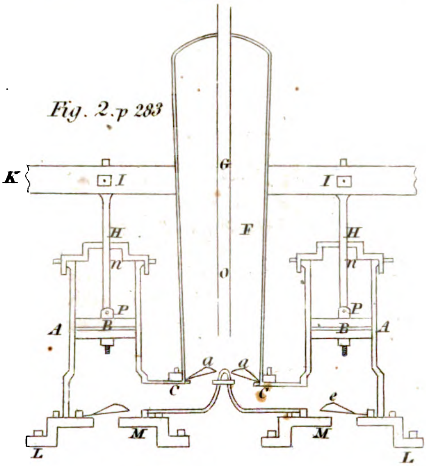


Fig. 4. p 284

Fig. 3. p 283

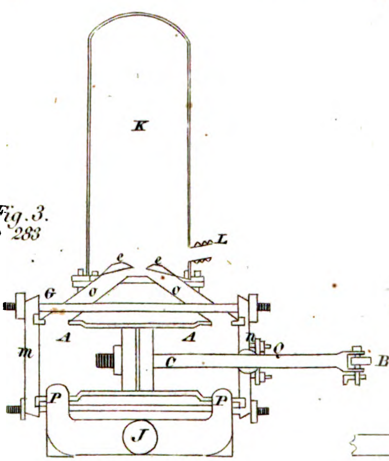
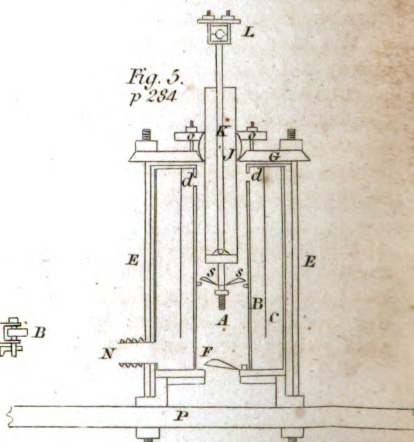


Fig. 5. p 284



THE

FRANKLIN JOURNAL,

AND

AMERICAN MECHANICS' MAGAZINE;

DEVOTED TO THE USEFUL ARTS, INTERNAL IMPROVEMENTS, AND GENERAL SCIENCE.

MAY, 1827.

On Fire Engines, Hose, and some other apparatus manufactured and used in Philadelphia, for the purpose of extinguishing fires.

THE history of the origin, progress, and present state of the Engine and Hose companies in this city, is a desideratum, and were the facts respecting them carefully collected, and well detailed, it would be a very interesting article, and a document worthy of being preserved. Should we not be able to induce some one of our friends to undertake the task, we are determined to enter upon its performance ourselves, and shall be obliged by the attention of those who may aid us by furnishing any information upon the subject. We know of no city which can compare with our own, in the possession of the means for extinguishing fires, and the promptness and efficiency with which they are applied; nor of any association of individuals with larger claims to the gratitude and support of the community in which they live, than our Engine and Hose companies.

We have, in some of our former numbers, made extracts from Carey and Lea's edition of Nicholson's Operative Mechanic, and particularly of those parts which were furnished, for that edition, by the mechanics of our own country. The following article is of that description; we copy it as it appeared, and subjoin some observations from a correspondent, intended to correct such parts of it as he considers to be incorrect. EDITOR.

"Owing, perhaps, to the peculiar organization of the fire department of this city, (Philadelphia,) which is supported solely by the zeal and public spirit of private volunteer associations, with but slender pecuniary assistance from the city authorities, great emulation and rivalry exist, and the attention of ingenious men attached to

them has been directed to the improvement of the fire apparatus, and their exertions have been attended with corresponding success. The introduction of rivetted hose was perhaps the most important improvement in our means of extinguishing fires, and without it no apparatus should be considered as perfect. It is made of sole-leather dressed to an even thickness and breadth, lapped over and rivetted with iron or copper tinned rivets, which are introduced from the inside of the tube, has a burr placed upon its point which is then rivetted down, and closed with a hollow-set punch; the cross joints are secured diagonally, by a double row of rivets. Fifty feet thus made form a section, having at each end a screw, one male and the other female, turning upon a collar, and forming a swivel. An indefinite number of sections may be attached without twisting the hose. The merit of introducing the important improvement of rivetted hose, belongs to the Philadelphia Hose Company of this city, under whose direction and at whose expense the experiments were tried, and brought to its present state of perfection. The committee who executed the work were Messrs. Sellers, Pennock, and Morris.

Many important improvements have been made in the fire-engine also, especially in the form and arrangement of the various parts, and in the perfection of the workmanship.

Fig. 1. in the plate, exhibits a side view of an engine in the form preferred, and adopted, by most of our firemen. The levers are of a shape introduced by Mr. Perkins, and are by far the most convenient of any now in use. The handles hinge upon studs in the centre of the cross-bars attached to the end levers, and when put in operation fall into clasps at the extremities, and are there firmly retained. The improvement in the form of the levers was first made by Mr. Adam Eckfeldt.

Fig. 2. represents the working parts of the same engine. A A are the chambers or pumps, which are made of brass. The part in which the piston works is bored and polished; they are bolted down upon the seats M, which are in like manner secured to the bottom of the engine by bolts through the feet L. The pistons B B are two metal disks, each enclosed in leather, pressed into the form of a cup; the bottoms of these cups come in contact with each other, and the disks, and leathers, are firmly connected by the piston rods *n n*. The centre of the levers being permanent, these rods are made to work on a moveable pin P, and passing through the guide H, are alternately raised and depressed by the motion of the lever K, (a portion of which is represented,) moving upon its centre G. When the piston is raised the chamber fills with water, which is forced into it by the pressure of the atmosphere on the surface, through the opening in the seat M. It is then depressed, the valve *e* closes, and the water passes up through the water-way *c* into the air-vessel F, and is there retained by the closing of the valve, or until by the frequent and alternate operation of the pistons, the air in the air-vessel is so far condensed, that by its re-action it forces the water through the pipe O, on any object towards which it may be directed.

This engine is on precisely the same principle as Newsham's, and

differs only in the mechanical arrangement and structure, in which it is decidedly superior, being by far more simple.

Fig 3. represents another variation in the pump of the fire-engine, with the origin of which we are unacquainted, but believe it to be French. It consists of a cylinder of brass A A, laid horizontally, the piston working in the same direction, the rod being attached to drops, at right angles with the levers, which have the same form as those last described. When the piston is moved, the water follows by atmospheric pressure through the pipe, entering by the circular aperture J. On the return of the piston, the valve at P closes, and the water is forced through the water-way *o*, into the air-vessel K, its return being prevented by the closing of the valve *e*, it is discharged through hose leading from the pipe L. The same takes place alternately on moving the piston back and forward. The piston rod B, is a permanent rod of polished iron, working through the stuffing-box Q, attached to the cap *n*; *m* and *n* are cast-iron caps fitted to the ends of the chamber, and are rendered air-tight by leather, or leaden joints, securely connected together by bolts passing the length of the chamber, with a nut on each end. This description of engine is liable to some objections. It is, however, advantageously used in machines called *Hydraulions*, which are a combination of a hose-carriage and engine in one. It is compact, and can therefore be arranged so as to carry a large quantity of hose on the body, without making it too unwieldy. On the other hand, it is very liable to get out of repair, and difficult to put in order; in fact, to perform this operation, the whole works must come out. Again, owing to its position, all dirt and gravel that finds its way into it, naturally settles to the lower side, and wears that part away before any other; very soon making the chamber oval, and of course not perfectly water-tight. It is, however, well adapted to suctions, as the chamber being constantly full of water on both sides of the piston-head, no air can pass to destroy the effect.

Fig. 4. is a suction tube, on a new and improved construction, and is an admirable substitute for the leathern suction hose formerly used, possessing all its advantages without its defects. It is formed of copper tubes, *e*, *e*, *e*, five feet long, connected at each end by joints B, moving upon themselves, called swivel joints, thereby making the whole tube flexible. The pipe is here represented folded up in the form as carried on the engine, and may be extended at pleasure by unfolding the joints to the length of seventeen or eighteen feet. C is the female screw which attaches it to the outside of the engine, which is perforated, and furnished with a male screw; when thus fixed, it is forced against a leather collar within the aperture J in the suction-seat attached to the horizontal chamber, fig. 3. D, fig. 4, is a bulb of copper pierced with holes, which let the water pass, and excludes all dirt and other matter which would be injurious to the works of the engine.

Fig. 5. is a sectional view of Perkins's single-chamber engine. A is the working chamber, of copper, or brass, having small holes *d*, *d*, near the top, through which the water passes. B is a division cylin-

der between the chamber and air-vessel, and is firmly secured at the top, while the lower end terminates within three inches of the bottom of the chamber, and is intended to form the inner coat of the air-vessel. The whole is surrounded by a cylinder *c*, which forms the outer coat of the air-vessel, and is, at both ends, connected with the chamber by a plate formed of soft solder ⅜ths of an inch thick, into which they are firmly incorporated. The whole stands upon a seat of brass, having an opening through which the water passes, and which is closed by the valve F. The chamber is firmly bolted to the top of the engine by bolts passing through the cap G, secured by nuts. K is the plunger of copper, made perfectly cylindrical, the capacity of which is half that of the chamber; it works through a stuffing-box *o*, *o*, made perfectly tight by bolts secured in the caps. J is the piston rod, moveable on the joint at M, which gives a perpendicular motion to the plunger. L is the piston head, through which is passed the cross-bar of the levers, which are similar to those first described. The operation of this engine is different from any other in use, or known by us, and was, we believe, a new idea of Mr. Perkins. Suppose the plunger or piston raised, water flows through the valve F by atmospheric pressure, and the whole capacity of the chamber below the plunger is filled. It is then depressed. The lower valve F closes, and those in the box *s s*, attached to the plunger, open. The plunger, we have already noticed, is exactly one half the size, or capacity, of the chamber; consequently, when the plunger is depressed, one-half the water which passes through the valve *s s* remains in the space between the chamber and plunger; the other half passes through the small holes *d d*, down the space between the chamber and division B, and thence through the discharge pipe N. When the plunger is raised again, the upper valve closes, the water which remained passes out through the same openings as before, and the chamber below the box is again filled, and the same operation is repeated at every stroke of the levers; thus a continued stream is sustained with one chamber, the water being projected both by the up and down stroke.

The only recommendation which can be given to this engine over the double chamber, is, that while the same effects are produced, the expense of the machine is decreased twenty per cent. But no form of engine is so simple, durable, or easily repaired, as those represented in figures 1 and 2.

The action of the *air-vessel* (F, fig. 2.—K, fig. 3.—C, fig. 5.) is well explained in the description of the operation of Newsham's engine, and is as follows:

The principles on which this engine acts, so as to produce a continued stream, are obvious: the water being driven into the air-vessel, as in the operation of common sucking and forcing pumps, will compress the air contained in it, and proportionably increase its spring, since the force of the air's spring will be always inversely as the space which it possesses; therefore, when the air-vessel is half filled with water, the included air, which, in its original state, counterbalanced the pressure of the atmosphere, being now compressed

into half the space, its spring will be equal to twice the pressure of the atmosphere; and by its action on the subjacent water, will cause it to rise through the conduit-pipe, and play a jet of thirty-two or thirty-three feet high, abating the effect of friction. When the air-vessel is two-thirds full of water, the space which the air occupies is only one-third of its first space; therefore, its spring, being three times as great as that of the common air, will project the water with twice the force of the atmosphere, or to the height of sixty-four or sixty-six feet. In the same manner, when the air-vessel is three-fourths full of water, the air will be compressed into one-fourth of its original space, and cause the water to ascend with the force of three atmospheres, or to the height of ninety-six or ninety-nine feet, &c. as in the following table:

Height of the water.	Height of the compressed air.	Proportion of the air's spring.	Height to which the water will rise.
$\frac{1}{2}$	$\frac{1}{2}$	2	33 feet.
$\frac{2}{3}$	$\frac{1}{3}$	3	66
$\frac{3}{4}$	$\frac{1}{4}$	4	99
$\frac{4}{5}$	$\frac{1}{5}$	5	132
$\frac{5}{6}$	$\frac{1}{6}$	6	165
$\frac{6}{7}$	$\frac{1}{7}$	7	198
$\frac{7}{8}$	$\frac{1}{8}$	8	231
$\frac{8}{9}$	$\frac{1}{9}$	9	264
$\frac{9}{10}$	$\frac{1}{10}$	10	297

There is not, however, as some suppose, any power gained by the use of the air-vessel; the only advantage obtained by it is, that the re-action of the condensed air serves to keep up a constant pressure on the water in the air-vessel, and sustains the stream perfect at the moment of the return stroke. The table showing the distance to which air of several degrees of condensation will project water, which closes the above quotation, may be very true in theory, but is not found to be so in practice, because the resistance of the atmosphere increases in a greater ratio than the velocity of the water; and beyond a certain distance the water cannot be projected, as it is found the resistance becomes so great as to disperse and separate the stream into small particles when projected with great velocity.

Operat. Mech. Am. Ed.

FOR THE FRANKLIN JOURNAL.

Observations on an article on the subject of Fire Engines and Hose, which appeared in the American edition of Nicholson's Operative Mechanic.

Mr. Editor—Having been informed that it is your intention to publish the article respecting Fire Engines, Hose, &c. which was furnished by some person in this city for insertion in Carey and Lea's edition of Nicholson's Operative Mechanic, I have thought that it would comport with your views, to admit into your Journal, some

remarks upon certain singular perversions, and evasions of fact, which exist in the statement there made; more especially as respects the introduction of the rivetted hose, by the Philadelphia Hose Company.

The writer of the article in question, says, that "the merit of introducing this important improvement, belongs to the Philadelphia Hose Company of this city, under whose direction, and at whose expense the experiments were tried, which have resulted in its present state of perfection. The committee who executed the work, were Messrs. Sellers, Pennock, and Morris."

Connected with the Philadelphia Hose Company from its origin, and well acquainted with its proceedings, I can safely aver, that the above statement is calculated to make impressions which are radically incorrect. I would be one of the last to detract from the credit due to that company. The improvement in question, and many others of great value, have arisen under its auspices, which have produced in a very prominent degree, the peculiar and improved system which now prevails in the extinguishing of fires. To it belongs the credit that the invention originated, and was perfected by members of the company, whilst it also stands in relation to it, in the interesting character of its original patrons. These, however, are the limits of its claims, as the invention must necessarily have had its origin in, and been consummated by the skill of, some individual mind, or minds. The reader of the above extract, fully aware of this, would be led to suppose, not that the Philadelphia Hose Company were the inventors, but that some one of its members, *not named*, had devised and dir<cted the plan, and that those of its members who *are named*, were merely the executive instruments,—the machine,—for carrying that plan into effect.

There is no foundation whatever for introducing the name of *Morris*, as one of the committee "who *executed* the work." The first suggestion of rivetting the hose, was made by Abraham Pennock, and the plan of forming the seam by a metallic connexion, by James Sellers. A resolution was then submitted to the company, for appointing a committee, to make, at the expense of the company, *such experiments* on the structure of hose, as *that committee* should deem adviseable. James Sellers, Abraham Pennock, and Jonathan Wainwright were appointed; the last named person has publicly disclaimed all participation in devising, or executing the work performed by the committee. Whatever credit therefore appertains to the inventors and executors of the improvement, belongs exclusively to the two members first named; a fact which has never been disputed by the company, and which has been indisputably proved before a jury.

The next item which I shall notice, is in the following words. "Fig. 3, represents another variation of the fire engine pump, the origin of which we are unacquainted with, but believe it to be French."!!

With respect to the engine, the following facts might readily have been ascertained by the writer of the above paragraph. William P. Morris, a member of the Philadelphia Hose Company, on observing

the compactness of Rowntree's fire engine, conceived the idea of fixing one of these engines on the same carriage with the hose; this idea he communicated to James Sellers, who arranged the plan, and prepared a model of this combined apparatus, which was approved, and adopted by the company. The existence of the embargo, frustrated the intention of importing an engine; and James Sellers proposed as a substitute, a cylinder similar to that described in the article, which proposition was also adopted. This invention, which originated out of a particular necessity, was variously modified in its details, as the execution of the plan progressed in the hands of the original proposer. It may also be observed, that the term HYDRAULION, now well understood, was invented to designate this novel machinery, of which this pump formed a striking particular.

As no stress is laid upon the position of the air vessel, though represented as vertical in the figure, it is merely necessary to remark, that though it so existed in the first hydraulion, it is not pursued, nor is it compatible with the present mode of constructing this combined machinery: in mere fire engines the erect air vessel is used. It is a *discovery of Sellers and Pennock*, that a *follower* or piston in the air vessel, effectually separating the air and water, is very advantageous in producing a uniform jet.

The article proceeds to state that "this description of works has some objections." Perhaps it is intended to confine these objections to what follows on the next page. "It is very liable to get out of repair, and difficult to put in order; in fact, to perform this operation, the whole works must come out." Now, the last mentioned circumstance is just as much the predicament of the double chamber engine as of this; and the prior assertion is *contrary to all experience*. The fact is, it is not so liable to get out of order as the pump on the old plan, because it is less complex; and any scientific man will assuredly come to the same opinion, on comparing the two plans, as exhibited in figures 2 and 3.

The article, in conclusion of these objections, states that "owing to its position, all dirt and gravel that finds its way into it, naturally settles to the lower side, and wears that part away before any other, very soon wearing the chamber oval, and of course not perfectly water tight."

The above paragraph conveys not merely a theoretical opinion, but a positive assertion that, conformably with the theory, a chamber whose position was horizontal, *has been* worn oval. The occurrence of such a fact is denied, and after the experience of so many years since hydraulions have been used, it may safely be concluded that it never will occur. The pump of the Phœnix hydraulion, is made simply of *sheet copper*, and has been in use about seven years. It has been probably used at almost every fire since it was built. Had the effect above described taken place, the cylinder must long since have burst. It remains, however, perfect and entire, and appears likely to remain a standing evidence of the fallacy of the foregoing theory.

It is difficult to conceive how any material which has gained access into the pump by *being suspended in the water*, and it must be

so suspended, either by its own levity or the agitation of the fluid, to get there at all, can be suddenly precipitated to the bottom, during the momentary period it remains in the pump, and while a continued agitation of the fluid is maintained by a rapidly moving piston. If it were necessary to show further, that the objection started has no solid foundation to rest upon, we might instance the pumps which have been in *daily use* for two or three years at Fair Mount water works, the position of these being horizontal, and no such effect having been produced.

In relation to the suction tube, fig. 4, it is the invention of Sellers and Pennock, and principally of Coleman Sellers, one of that firm. A description of it is given in the American edition of the New Edinburgh Encyclopædia, Vol. XVI, page 203. The difference in the manner of connecting the caps, is immaterial, and does not impair the claim of Sellers and Pennock, to be considered as its inventors.

On the preference which the article gives to the double chamber engine, over every other construction, I would, in conclusion, remark, that the double chamber engine has been long in use, has been well tried, and will perform well; and that any innovation in the form of a useful machine, will be regarded by the community with distrust; but it has a powerful competitor in the horizontal single chamber engine, which can be made *cheaper*, is more simple, and is equally substantial and efficient.

It is to be regretted that a work like that of Nicholson's, should have been chosen for the purpose of throwing into the shade, the just claims of individuals whose labours have been productive of public benefit; or of disseminating opinions which are erroneous, in consequence of the carelessness with which they have been collected.

SCRUTATOR.

ON THE NATURE AND PROPERTIES OF TIMBER.

Extracted from "The Elementary Principles of Carpentry, by Thomas Tredgold."

[Continued from page 149, vol. ii.]

Of the Structure and Classification of Woods.

To the experienced eye of a workman the general appearance of each variety of wood has become so familiar, and its most obvious characters are so strongly impressed on his memory, that he readily knows them one from another; but, nevertheless, the notice of some characters that are peculiar to certain kinds of woods may be of use, especially to young men, who will find both information and amusement in making collections of specimens, in examining their properties, and in rendering themselves familiar with their uses.

In a section of a tree it clearly appears that the wood is composed of separate layers, or rings, regularly disposed round the pith, which is in general nearly in the centre of the tree; but the thickness of these layers is seldom if ever perfectly regular.

When examined by a magnifier, the wood appears to consist of fine divisions, like rays, spreading from the pith to the bark, with pores between them, often empty, but sometimes filled with some kind of vegetable matter. In the resinous woods most of the pores are filled.

Besides the fine divisions, which are often scarcely to be distinguished by the naked eye, there are, in some woods, other divisions that are larger, like larger rays passing from the pith to the bark; they are generally of a light silvery colour, and are called the silver grain, or larger transverse septa. When a piece of wood is cut so as to pass obliquely through the larger septa, or silver grain, it produces that fine flowered appearance so well known in the oak.

The fine divisions, or lesser transverse septa, are common to all woods except the palm, though in some they are not very distinct; but there are only some kinds that have the larger septa, or silver grain;* therefore this forms a natural character for distinguishing the kinds of wood. And they may be divided into two classes, one that has, and the other that has not, the larger septa, or silver grain.

Again, in some woods, each annual layer or ring seems to be nearly uniform in its texture, and the line of separation between the layers is not very distinct, being so indistinct in some woods as to be "as it were shadows of circles, nothing real." Mahogany is an example of this structure; and the robinia caragna of Hill, is of this kind.

But in other woods, one part of the layer is nearly compact, and the rest of it presents the appearance of a circle of empty pores; of which we have an example in the ash. This structure is remarkably distinct in Hill's section of the arbutus.

There is a third kind, in which nearly all the pores appear to be filled with resinous or gummy matter; and one part of the layer consists of a compact, hard, and dark coloured substance, the other part is lighter coloured, and softer. All the resinous woods are of this kind.

According to these distinctions, the arrangement of the following table is made.

WOODS.	CLASS I.—With larger transverse septa.	*Division* 1.—Very distinct annual rings, one side porous, the other compact.	Oak.
		Division 2.—Annual rings not very distinct, and their texture nearly uniform.	Beech. Alder. Plane. Sycamore.

* As the term silver grain is used to denote both the smaller and larger septa, I shall follow the example of Mr. Ellis (Vegetable Anatomy, Supplement to the Encyclopædia Britannica, p. 332) and employ the terms larger transverse septa, and lesser transverse septa. I would rather have used the term silver grain; but if so, it must have been in a restricted sense, and in such cases new terms are less likely to mislead.

WOODS.	CLASS II.—No larger transverse septa.	*Division* 1.—Annual rings very distinct, one side porous, the other compact.	Chesnut. Ash. Elm. False acacia.
		Division 2.—Annual rings not very distinct, and their texture nearly uniform.	Mahogany. Walnut. Teak. Poplar.
		Division 3.—Annual rings very distinct, pores filled with resinous matter; one part of the ring hard and heavy, the other soft and lighter coloured.	Cedar of Lebanon. Larch. Yellow fir. White fir. American pine. Cedar.

The only properties of wood that seem to require explanation, are the cohesive force, the modulus of elasticity, the stiffness, the hardness and the toughness.

The *cohesive force* of a bar or beam is equal to the power or weight that would pull it asunder in the direction of its length. The weight that would pull asunder a bar of an inch square of different kinds of wood has been ascertained by experiments. Of these experiments I have taken the highest and lowest results for each kind of wood. Experiments have been made by Muschenbroek, Emerson, Rondelet, Anderson, and Barlow.

The *modulus of elasticity* is the measure of the elastic force of any substance. Dr. Thomas Young has by means of it given some very elegant demonstrations of the laws of resistance. As it is the measure of the elastic force, its use must be evident when it is considered that it is only the elastic force of timber that is employed in resisting the usual strains in carpentry; and the learned reader will readily perceive, that the constant numbers in my rules for the stiffness of timber, have for one of their elements, the modulus of elasticity.

By means of the modulus of elasticity, the comparative *stiffness* of bodies can be ascertained. For instance, its weight for cast iron is 18,240,000 pounds, and its weight for oak is 1,714,500 pounds. Hence it appears that the modulus for cast iron is 10·6 times that of oak, and therefore a piece of cast iron is 10·6 times as stiff as a piece of oak, of the same dimensions and bearing.

A *hard* body is that which yields least to any stroke or impressive force; and it may be shown, by the principles of mechanics, that in uniform bodies the degree of yielding is always proportional to the weight of the modulus of elasticity; therefore, a table containing the weights of the modulus of elasticity of such bodies, shows also their relative hardness and stiffness.

The relative hardness is determined with considerable accuracy by means of the modulus of elasticity; but the methods used for

ascertaining the hardness of mineral bodies is very defective; and the method proposed by Dr. O. Gregory, from the theory of percussion, is not susceptible of any tolerable degree of accuracy, from the difficulty of making correct experiments.

As the hardness follows the same laws as the stiffness, cast iron is 10·6 times as hard as oak. But it is necessary to inform the reader, that when the substance is not uniform, the hardness thus found is that of the hardest part. Thus, in fir, it is the darker part of the annual ring that is the hardest, and which determines the extent to which a beam will bend without fracture. Dry wood is harder than green, consequently it is more difficult to work. The labour of sawing dry oak is to that of sawing green, as 4 is to 3, nearly.

In respect to the *toughness* of woods, that wood is the toughest which combines the greatest degree of strength and flexibility; hence that wood which bears the greatest load, and bends the most at the time of fracture, is the toughest. From the data obtained in the course of my experiments, the comparative toughness has been ascertained; except in a few instances, where I had not specimens sufficiently long for experiments. In such cases Mr. Barlow's experiments have been calculated from.

The opposite to hardness, is softness, the opposite to toughness is brittleness, and the opposite to stiffness is flexibility; therefore, when the hardness, toughness, or stiffness of a wood is expressed by a low number, it may be considered to have the opposite quality.

I have made oak the standard of comparison, and have considered its strength, toughness, and stiffness, each to be 100; and in so doing, the mean strength of oak is taken at 11,880 pounds per square inch, and its modulus of elasticity at 1,714,500 pounds for a square inch.

Having thus laid before the reader the means adopted for arriving at the properties of the woods, I scarcely need say, that it is those properties which determine its fitness for the different purposes of carpentry. In some cases stiff woods are required, as in the joists and rafters of a building; in other cases tough woods should be employed, as for the shafts of carriages; and in other cases strength is necessary, as in ties, and other timbers strained in the direction of their length.

Tough woods, which are also hard, are the most difficult to work, especially if cross grained; on the contrary, brittle woods work easily: and hard woods preserve the best surface.

In general, where straightness is desirable, stiff woods should be preferred; where sudden shocks are to be sustained, tough woods are the best; where little strength is required, but much labour is to be put upon it, a brittle wood is desirable; and where a fine surface is to be preserved, a hard wood should be chosen: so that it is not in carpentry alone that these researches will be useful, for they are equally applicable to any art where timber is employed.

On the preparation of Catgut for various uses.

(Continued from page 225.)

Catgut *for Rackets or Battledores.*—The intestines of sheep, after they have been steeped in the alkaline ley, are cut slantwise, if they are in short lengths, and sewed together; carefully placing the slants in a direction contrary to each other, that the seams may not render the cords of an unequal size. This being done, and the intestines formed into one piece, it must be soaked in ox-blood, to give it the proper colour, and then be stretched on a proper frame; after which, one, two, three, or four of the intestines, according to the required size of the cord, are fixed to a piece of tape, and the other ends are turned twice round a peg. This done, the workman takes the tape, applies it to a hook on a spindle, and gives a few turns of the handle. As the cord shortens by twisting, it must be well stretched; and when this is effected, the workman squeezes the cord between his finger and thumb throughout its whole length, to remove all its humidity, and produce an equal thickness in every part of it. One or two hours after, he twists it again, and rubs it with a horse-hair cord, wetted.

Thinner cords are made of only one intestine; operating as we have before indicated.

Catgut for Whip-handles.—Sheep's intestines, prepared with potash, are used for this purpose. The workman cuts them slantwise, and sews them together, observing always to keep them of an equal size. They are then stretched, and twisted at each end: it is very rare that this sort of cord is made of two intestines. They are then bleached, by the fumes of burning sulphur, once or twice; and sometimes coloured; as they readily receive any dye. Common ink is used for a black colour, and red ink for a rose colour, which is sometimes rendered lighter by a little sulphuric acid. A green colour is given by a composition sold for that purpose, by colourmen, to the manufacturers of catgut.

Catgut for Hatters' Bows.—These are made of sheep's intestines, of the longest and largest kind, after being prepared with potash, by twisting together, from four to twelve of them, according to the size required. They are usually made from fifteen to twenty-five feet long. During the twisting, the cord is placed in a long box, from eighteen to twenty inches in breadth, and a few inches high, in order to keep it clean, and prevent it from trailing on the ground. The box is called the *refresher.*

This kind of cord must be void of seams and knots; to accomplish which, the workman attaches the intestines to a piece of tape, hangs them on a peg, and draws the whole of them straight, to fit their other ends to another peg; in doing which, if he finds the intestines too short, he makes a hole in their ends, and threads into them short pieces, till the whole is long enough to reach the other peg, placed at a given distance from the first. These ends are then affixed to a piece of tape, and fastened to the peg. This done, he applies them

to the twisting-wheel, rubbing the cord well between his finger and thumb throughout its whole length, at every turn of the wheel, in order to make it of an equal size. When about half-dry, they are exposed twice to the fumes of sulphur; after each time, the cord must be well stretched, and moistened with plenty of the solution of potash, at the same time rubbing with the hair-rubber. It is then left to dry, and afterward cut, and coiled up for sale.

Catgut for Clockmakers.—This kind must be very fine, and of course requires the smallest intestines, well prepared with potash. Sometimes they are made by cutting, with a particular kind of knife, the intestine into two strips. The knife, which is fixed to a table, has two edges, in opposite directions; and above them, a ball of lead, which is introduced into one end of the intestine; and by drawing the latter continually over the ball, the projecting blades cut it into two strips, which the workman holds, one in each hand, drawing them regularly, till it be cut quite through.

Watch and clockmakers also use catgut of various sizes, consisting of more than one intestine, and made like the musical instrument cords, which we shall next describe.

Catgut for Musical Instruments.—Of all the cords from intestines, this kind is the most difficult to make, and requires the greatest care and ability of the workmen. It is acknowledged, that for many years they have been made as well in France as in Italy, with the exception of the treble-strings for violins, which our manufacturers have not been able to imitate, but on a very limited scale. This is owing either to the difference in quality of the intestines, or some other unknown cause. Whatever it be, we are still tributary to Naples for this article; and every exertion ought to be made to free us from this necessity. Experiments, made with skill, will no doubt succeed; and the Society for the Encouragement of National Industry, by calling the attention of artists to this subject, will have the glory of contributing to the perfection of an art, of which little is at present known.

The cleaning and scraping of the intestines for this purpose, to free them from the fat, must be done with much more care than is requisite for other cords, and when they have undergone that process, they must be steeped in an alkaline lye, prepared as follows:

An earthen pan, holding six quarts, is filled with water, and three pounds of potash are added to it, which must be well stirred, and suffered to subside. In a similar vessel, full of water, placed by the side of it, are put five pounds of pearlash, leaving that also to settle. If it be wished to make use of this solution within a short time, it will be necessary to add to it a little alum-water, which will clarify it quickly.

The scraped intestines are now put into earthen pans, so as about to half fill them. The pans are then filled up with the solution of potash, with as much water added, as to double the quantity of fluid. This liquid is changed twice a day, increasing its strength each time, by adding more of the solution of pearlash, and diminishing progressively the quantity of water, so that the last solution be the

strongest. The intestines gradually become whiter, and begin to swell. After having suffered them to macerate from three to five days, or more, according to the state of the atmosphere, the operation proceeds as follows—

Every time that the alkaline solution is changed, the pans are placed upon the box called the *refresher*, placed on a table, or on tressels, in a slanting direction, so as to facilitate the running off of the water. This box must be large enough to hold the frame on which the cords are to be stretched. The intestines are scraped with the edge of a copper-cube, held in the left hand. The forefinger of the left hand is placed near to the edge of the copper-cube; whilst, with the right hand, each intestine is drawn over the edge of the disk, or cube, and between the forefinger.

When they have all been treated in this manner, and placed in a fresh pan, a stronger alkaline solution is poured on to them than that from which they were last taken, as we have before mentioned. This operation is necessary for cleansing the intestine of its greasy quality, and bringing the cords to perfection.

As soon as it is perceived that the intestines begin to swell, and some little bubbles appear on their surface, (for in this state they rise in the water,) it is necessary to twist them *immediately*, or they will begin to shrivel, which sometimes happens, particularly in summer, and occasions the loss of the intestines, and also the time spent over them. In hot weather, the intestines are, indeed, most easily cleaned from fat; but then the workman must be more than ordinarily attentive, and the different leys for the washings must be made stronger with alkali, and applied more quickly. In winter, all goes on in better order, and the operation is more certain. The manufacturers of this article generally place their workshops in cool places, where there is a little dampness.

The intestines being now ready to be twisted, they are taken out of the alkaline solution. Some manufacturers plunge them again into fresh water, and wash them well therein; but, although they become by this method of a better colour, and take the sulphur better, they run the risk of being weakened.

To twist and finish the cords, a machine is used—a kind of frame, two feet high, and five feet long; on one end of which are placed a number of pegs, and in the opposite end are bored, with a large auger, a number of holes, inclined in such a way, that when pegs are placed in them, to attach the cords to, they may not be liable to slip and come out. The intestines are now selected, according to their size; and two or three of them are taken, and the ends twisted round one of the pegs first placed, and the other ends are carried to the opposite ones, and attached to them. Two turns of the intestines around the pegs, are sufficient to prevent their slipping. When fixed to the pegs, they must not be drawn tight, as they would be subject to snap during the twisting, if sufficient play were not given to them for that operation.

If any of the intestines should be found too short to reach the opposite side of the frame, they must be lengthened, by pieces cut off

any others which may be too long; and care must be taken to make the ligature near the last-placed peg, to preserve the cord of an equal size in its whole length, as otherwise it would be false in its tone.

The frame being filled up in the manner we have described, two or three of the pegs, bearing one end of the intestines, are fixed to spindles, if the machine contains several, and turned round several times, passing the finger and thumb of the left hand frequently from one end of the cord to the other, beginning at the spindle. When all the cords have undergone this operation, and the pegs are all replaced, the whole frame is placed in the sulphuring closet, with several others, as it would not be worth while to sulphur one at a time.

The sulphuring closet is placed in a damp place, surrounded as much with water as possible. An earthen vessel, containing the sulphur, is placed in it, with the frames; the sulphur is then set on fire, and the closet well closed in every part, to confine the fumes. When the cords have remained a sufficient time—which, of course, varies in some measure, according to circumstances—the frames are taken out, and placed on the *refresher*, and rubbed with a horse-hair cloth. This done, they are again placed in the frame, twisted anew, and returned to the sulphuring closet, to undergo the same process as before. If the state of the atmosphere require it, the whole of these processes must be twice or thrice repeated; and they are then left to dry.

When the cord is sufficiently dry, it is known by its not running up when a peg is taken out, and remaining stiff and straight, instead of flagging. If dry enough, they are well oiled with good olive oil, and coiled up into rings for sale. They become better by being kept some time.

To make the fourth strings for violins, or any other sized cords, intended to be covered with metal wire, the process is so well known, that it need not be here described.

The whole success of these operations depends principally on the ability and experience of the workmen, in managing the different washings, stretchings, and twistings, and in a judicious use of the sulphur. When the cord is too much sulphured, it readily snaps; and, on the contrary, when it is not enough so, it stretches too much, and never keeps in tune.

We may conclude, that there is no fixed rule yet adopted for the success of this branch of manufacture; but we have much expectation, that, with the aid of the Society for Encouraging National Industry, we should soon succeed as well as the Italians.

FOR THE FRANKLIN JOURNAL.

MECHANICAL JURISPRUDENCE.—No. XVI.

BY PETER A. BROWNE, ESQ.

On the Law of Patents for new and useful Inventions.

JOINT AND SEVERAL PATENTS.

We shall now proceed to inquire into the nature of joint, and several, patents, and the effect of taking out the one, or the other of them.

In the first place, *there may be a joint patent for a joint invention.*

In the case of Barrett *v.* Hall, 1 Mason's Reports, 472, this rule is laid down. Judge Story says, "A joint patent may be well granted upon a joint invention. There is no difficulty in supposing, in point of fact, that a complicated invention may be the gradual result of the combined mental operations of two persons acting together, *pari passu*, in the invention. And if this be true, then, as neither of them could justly claim to be the *sole* inventor in such a case, it must follow, that the invention is joint, and that they are jointly entitled to a patent. And so are the express words of the patent act, which declares, that if any person or *persons* shall allege, that he or *they* have invented, &c. a patent shall be granted to him or *them* for the invention."

The statute of James, also, speaks of "inventor or inventors," thereby implying that there may be *joint* inventors. I have not been able, however, to find in any English adjudged case, that a joint patent may issue to joint inventors; but it is common in practice, to issue patents to two, or more, persons; the correctness of which practice does not appear to have been disputed.

The next rule is, that *a joint patent cannot be sustained upon a sole invention.*

For this, we must refer to the same authority as the last. "A joint patent," says Judge Story, "cannot be sustained upon a sole invention of either of the patentees; for the patent act gives no right to a patent, except *to the inventor;* and requires an oath from the party who claims a patent, that he is the *true inventor.*

And it is equally clear, that *the same persons cannot, at the same time, hold, jointly and severally, valid patents for the same invention.*

The reasoning of Judge Story upon this rule, is conclusive. He says, (in the case last cited,) "In the next place, a joint patent for an invention, is utterly inconsistent with several patents for the same invention by the same patentees. For it is impossible, that any person can be, at the same time, the joint, and the sole inventor of the same invention. If, therefore, each of the joint patentees obtain a several patent for the same invention, as his own exclusive invention, and afterwards, without surrendering the first patent, they obtain a joint patent for the same as a joint invention, either the former sole patents are void, or the joint patent is void. For, besides the apparent inconsistency of the patents, if *all* could be sustained,

then a recovery upon the joint patent would be no bar to a suit upon the several patents; and the parties might obtain a double recompense for the same infringement. There is an additional reason, which deserves great consideration; and that is, that if sole and joint patents could be sustained by the same parties for the same invention, they might be *successively* taken out, so the term of the exclusive right might be prolonged for a great length of time, instead of being limited to fourteen years."

In the case of Odiorne *v.* The Amesbury Nail Factory, 2 Mason's Reports, 28, we have a decision supporting this reason. Jesse Reed had obtained a patent in September, 1810, for a machine for cutting, griping, and heading nails; and he afterwards, in 1814, obtained a patent substantially for the same invention, the first patent remaining unrepealed. Upon this objection being taken, Judge Story said, "It cannot be, that a patentee can have in use, at the same time, two valid patents for the same invention; and if he can successively take out, at different times, new patents, for the same invention, he may perpetuate his exclusive right during a century; whereas the patent act confines his right to fourteen years from the date of the first patent. If this proceeding could obtain countenance, it would completely destroy the whole consideration derived by the public for the grant of the patent, viz. the right to use the invention at the expiration of the term specified in the original grant."

If joint inventors, by mistake, take out separate patents as for separate inventions, they are not thereby, afterwards, upon discovery of the mistake, absolutely estopped from taking out a joint patent for the same invention.

The following extract from Judge Story's opinion, in Barrett *v.* Hall, 1 Mason's Reports, 474, which, although not expressed with his usual clearness, will, it is apprehended, establish this position. "In the next place, if several patents are taken out by several patentees for several inventions, and the same patentees afterwards take out a joint patent for the same, as a joint invention, the parties are not absolutely estopped, by the former patents, from asserting the invention to be joint."

The acceptance of the subsequent grant of the second patent is an estoppel to the patentee to set up any prior grant for the same invention, which is inconsistent with the terms of the last grant.

For this rule, we must still have recourse to the opinion of Judge Story, in the case last mentioned. He remarks, "I am, therefore, clearly of opinion, that the grant of a subsequent patent for an invention, is an estoppel to the patentee to set up any prior grant for the same invention, which is inconsistent with the terms of the last grant."

In the cases mentioned in the rule respecting a patent taken out by mistake, it is *doubtful* whether the second patent can issue until the first be repealed, as void.

This doubt is suggested by Judge Story, in the manner following: "And I have very great doubts, whether, when a patent is once granted to any person for an invention, he can legally acquire any

right under a subsequent patent for the same invention, unless his first patent be repealed for some original defect, so that it might truly be said to be a void patent." While the first patent stands unrepealed, it is very strong evidence against the second patent.

SEPARATE PATENTS FOR THE SAME INVENTION.

A person cannot hold, at the same time, two separate patents for the same invention.

In the case of Odiorne *v.* The Amesbury Nail Factory, 2 Mason's Reports, 31, Judge Story adds to what was before quoted, the following sentiment: "I hold it to be the necessary conclusion of law, that the inventor can have but a single *valid* patent for his invention; and that the first he obtains, while it remains unrepealed, is an estoppel to any future patent for the same invention, founded on the general patent act. The public have, by the first patent, acquired an inchoate interest, which cannot be defeated by any merely *ministerial* acts of the officers of government." This was also decided in Huntington *v.* Morris, MS. Rep. C. C. U. S. New York, Thompson, Justice.

The next question is, whether it is not a valid objection to the second patent, that the patentee had a prior patent for the same thing, not surrendered, repealed, nor declared void. This objection cannot be surmounted; a prior patent must be got rid of, before a second can be taken out. Why should a second patent be taken out, before a prior one is avoided, although invalid, if the patentee was enjoying the full benefit of it? It is objected, that the patentee is in difficulty as to getting the first patent out of the way. But if the patentee should sue on the first patent, and the defendant should succeed in the suit, the patent would be declared void: and if the patentee had a right to the thing pretended, the objection to a prior patent would be removed.

THE KIND OF PROPERTY WHICH THE PATENTEE HAS IN THE INVENTION, AND IN THE PATENT.

In the United States, the inventor has a property in the invention, before the patent is taken out.

The act of congress does not, as before shown, *grant* him any thing, but *secures* to him the enjoyment of a pre-existing right.

This would also appear to be the rule of the English law, notwithstanding what is said of its being the free gift of the king; for if the inventor agree to inform another person of the secret, who binds himself in a penalty, not to avail himself, or take any advantage, of the communication, he may maintain an action for the breach of that contract.

Dickenson applied to Smith, to obtain a knowledge of his invention, and agreed, under a penalty of one thousand pounds, that no undue advantage should be taken of the communication made. Dickenson then entered a caveat, to prevent any one but himself taking

out the patent. He afterwards obtained a patent in his own name, but being unable to make out the specification, he obtained information from Smith, under an assurance, that he would take no advantage of the communication. He afterwards used the patent as his own invention; upon which, Smith sued for the penalty, and recovered.

The property which an inventor has in his invention, before a patent taken out, is inchoate, and imperfect.

Canham *v.* Jones, 2 Vez. & Beam. 221, was a bill, complaining of an imposition on the public, of a spurious composition, under the same name as the complainant's medicine, to the secret of which he had a legal right from the original inventor: but there was no patent. The defendant had judgment on demurrer.

The invention, before a patent taken out, would not pass under a commission of bankruptcy.

Hesse *v.* Stevenson, 3 Bos. et Pul. 565, was a case of an uncertificated bankrupt, who, after commission issued, took out a patent. In page 577, Lord Alvanley, C. J., says, "It is true, that the schemes which a man may have in his own head, before he obtains his certificate, or the fruits which he may make of such schemes, do not pass, nor could the assignees require him to assign them over, provided he does not carry his schemes into effect, until after he has obtained his certificate."

The first section of the act of 1793, declares, that the exclusive right shall be granted to the petitioner, or petitioners, his, her, or their heirs, administrators, or assigns: and the printed form of patents used at the patent office, conforms to this provision, inserting the word "*heirs,*" and leaving out the word "*executors.*" In the fifth and tenth sections, the word *heirs* is omitted, and the word *executors* appears: from which, I infer, that the word *heirs* was introduced into the first section by *mistake*. Be that, however, as it may, it is certain, that the patent is *personal* property, passing into the hands of the executors, and not into those of the heir.

The English statute mentions only the inventor, or inventors; and yet the patent always issues to him, or them, his, or their, executors, administrators, and assigns.

It was, in one case of O'Reilly, 1 Vez. j. 129, doubted by Lord Thurlow, whether letters patent could be the subject of a trust; but I agree with Mr. Godson, that it may. The English patents stipulate, that they shall not be assigned in trust to more than five persons.

THE TRANSFER OF THE PATENTEE'S RIGHT.

The next subject which demands our attention, is the transfer of the patentee's right.

It would seem, that *the inventor, or discoverer, may transfer his right, before a patent issued, and the assignee may take out a patent.*

The first section of the act of congress declares, that the exclusive right shall be granted to the petitioner, or petitioners, his, her, or their heirs, administrators, or *assigns.*

The inventor, or discoverer, may take out a patent, and assign it afterwards.

The fourth section of the act of congress states, "That it shall be lawful for any inventor, his executors, or administrators, to assign the title and interest in the said invention, at any time; and the assignee having recorded the said assignment in the office of the secretary of state, shall thereafter stand in the place of the original inventor, both as to right and responsibility; and so the assignees of assigns, to any degree."

The fifth section gives an action, if the invention is used by any one, without the consent of the patentee, his executors, administrators, or *assigns.*

The tenth section says, that the application to repeal a patent, shall be made to the judge of the district court, where the patentee, his executors, administrators, or *assigns*, reside; and directs the process to issue against the patentee, or his executors, administrators, or *assigns.*

In English patents, there is always inserted a condition, that, if the patentee shall make any transfer, or assignment, of it, or divide it into shares, or declare any trust, or seek public subscriptions, or shall presume to act as a corporate body, or do any thing contrary to the act of Geo. 1. so that more than five persons should in any manner become interested, and claim a benefit in the patent, it is declared void.

Under this condition, it has been decided, that executors and administrators, however numerous, being considered in law as one person, shall be entitled, in right of their testator, or intestate.

The patent, if taken out, passes under a commission of bankruptcy. Hesse *v.* Stevenson, Lord Alvanley, in 578.

A patentee may give licenses to persons to use his invention. Godson on Patents, 169. Tyler *v.* Tuel, 6 Cranch, 324.

The patentee, after an assignment of his interest, cannot set up an allegation that the patent is void.

In the case of Oldham *v.* Lanymead, cited by Lord Kenyon, in Hayne *v.* Maltby, 3 Term Reports, 439, 441, the patentee had conveyed to the plaintiff, his interest in the patent; and yet, in violation of his contract, he afterwards infringed the plaintiff's right, and then attempted to deny his having any title to convey. But Lord Kenyon was of opinion, that he was estopped, by his own deed, from making that defence.

An assignment, in order to entitle the assignee of the patent right to sue in his own name, alone, must be an assignment of the whole right.

Tyler *v.* Tuel. In the Circuit Court of the District of Vermont in 1804. The plaintiff was assignee of another, Tyler, the original patentee; and the suit was for a violation of the patent right. The assignment, set out in the record, was of all the right, title, and privilege, in any part of the United States, excepting in the counties of Chittenden, Addison, Rutland, and Windham, in the state of Vermont. After verdict for the plaintiff, a motion was made, in arrest of judgment, founded on the insufficiency of the plaintiff's title, as

set forth. On this question, the judges were opposed in opinion. The cause was removed to the Supreme Court of the United States, who arrested the judgment. According to their directions, the following opinion was certified to the Circuit Court for the District of Vermont: "It is the opinion of the court, that the plaintiffs, by their own showing, are not legal assignees to maintain this action, in their own names, and that the judgment of the Circuit Court be arrested."

The original patentee may assign a moiety of the patent right to another, who, with the patentee, may maintain an action in their joint names for an infringement of the right.

The king of England granted a patent to James Watt, for the sole benefit, &c. of his invention for lessening the consumption of steam, &c. and an act of parliament was afterwards passed, extending this benefit for 25 years, to Watt and his assigns. Watt assigned two thirds of this patent right to Boulton, and Boulton and Watt sued Bull for the violation of this patent. But although the case was disputed with great professional skill, the objection that Watt could not assign a part to Boulton, so as to enable them to sue jointly, was not taken.

This point was decided in the case of Whittemore *v.* Cutter, 1 Gallison's Reports, 429. It was an action for the violation of a patent right for the making of cotton and wool cards, brought jointly, by the original patentee, and his *assignee*, of a moiety of the right. After verdict for the plaintiff, it was moved that a new trial should be granted, on this, among other grounds, that the action could not be maintained in the above form. Story, justice, gave his opinion as follows: "The first objection is founded on the incompetency of the plaintiffs to maintain the present action; one of the plaintiffs being the *original patentee*, and the other an *assignee* of a moiety of the patent right, deriving his title under the patentee. It is contended, that no action will lie in this court, for an infringement of a patent right, in favour of an assignee, unless he be the assignee of the *whole title and interest*. And the language of the 4th sect. of the Act of 21st February, 1793, ch. 11, and the case of Tyler and al. *v.* Tuel, are relied on in support of the position."

"It is true, that a party relying on an action given by a statute, must bring himself within the provisions of the statute. But where, as in the present case, the law is *remedial*, it should have a *liberal* construction, to effectuate the intentions of the legislature. Upon the very rigid construction, which is assumed by the defendant's counsel, an action could not be maintained, where a joint patent should be obtained by two persons, and one of them should assign his whole interest. The action could not be *jointly* brought by the patentees, because one would have parted with his whole interest, nor *jointly* by the patentee and the assignee, for it would then be open to the very difficulty which is pressed upon us in this case; nor by either party *separately*, for it would be splitting the cause of action. Other cases might be put, in which the parties would be wholly without remedy. We are well satisfied, however, that the direction

given at the trial, on this point, was correct. The statute gives to the assignee *all* the right and responsibility, which the original inventor had in the undivided portion of the patent, which is conveyed; and an action may well be maintained by *all* the parties, who, at the time of the infringement, are the holders of the whole title and interest. The case of Tyler and al. *v.* Tuel, is clearly distinguishable. In the first place, it was brought by persons who did not purport to have the whole patent right in themselves. In the next place, there was, technically speaking, no *assignment* of the patent right. The instrument could only operate as a *covenant*, or *license*, for the exclusive use of the patent right in certain local districts. But a patent right itself is unsusceptible of local subdivision. Nor is the present case within any of the mischiefs which were pressed on the court in that case. The language of the 4th sect. does not seem to have contemplated the case of joint inventors; yet there can be no doubt that being within the *reason* of the clause, they must be held within the *purview*. If either should die, can there be a question that the executor or administrator might well maintain an action jointly with the surviver, for an infringement? And in what substantial respect can an assignee in law, be considered as distinguishable from an assignee in fact? Upon the most mature reflection, we are satisfied, that this objection cannot prevail *upon the footing of the statute;* and if urged at common law, the case of Bolton and Watt *v.* Bull, where the action was brought by the inventor and his *assignee* of two thirds of the patent, would afford a complete answer.

THE PRIVILEGE GRANTED TO THE PATENTEE.

The privilege granted by the English statute, is the sole working, or making of any manner of new manufacture.

The act of congress secures to the patentee, the full and exclusive right and liberty of making, constructing, using, and vending to others to be used, the said invention, &c.

The English statute, limits the period to 14 years. The words are "For the term of 14 years, or under."

The act of congress says, "For a term not exceeding 14 years."

Statutes are sometimes made in England, to extend the time of exclusive privilege. Godson on Pat. 148 and 158; so also have acts of congress been obtained, enlarging the time.

The time when the 14 years are to commence, is expressly stated in the statute; the words are, "the said fourteen years to be accounted from the date of the first letters patent or grants of such privilege."

On this subject the act of congress is silent. Judge Thompson, in the case of Huntington *v.* Morris, MS. Rep. C. C. U S. for the southern district of New York, seemed to think this discrepancy material to the construction. He said, that it appeared to be the settled law of England, that if an invention had been introduced into use *by the patentee himself*, and made known and used by others before the date of the patent, such disclosure and use would destroy the patent. That there was, however, a difference between the

English law and the act of congress on this subject. *In the English statute, it is stated precisely from what period the* 14 *years are to commence—they are to run from the date of the patent; there is no such phraseology in the act of congress.*

On cheap and easy methods of preventing Houses from taking fire, and on the necessity of establishing regulations to enjoin the adoption of some means of this nature in the Metropolis. By Mr. J. W. BOSWELL.

(Concluded from p. 170.)

THAT staircases should be made fire-proof, is also very important to the safety of a family; it is difficult to conceive, why the expense of cut stone should be so very much higher here than in France; I have seen in Lyons, complicated and difficult work of this nature executed, which would not have been attempted, had it cost a tenth of the price that would be charged in England; I shall only mention a single instance, which is the slab of a balcony, about ten feet long, and four feet broad, with two brackets, more than three feet each way, connecting it with a block of equal dimensions to the slab, and at right angles to it, which was to form part of the front wall of the house; and from which latter, another piece projected in the opposite direction to that of the brackets, intended to be built up in a party wall, and all this cut out of a single block of stone, and designed for an ordinary house in one of the new streets in the quarter Perrache. Stone stairs at first would, for the above reason, be rather expensive here; but it is probable, if there should be a considerable demand for them, that machinery would be applied for sawing out steps for them, near the stone quarries, which would cause them to be sold at a reasonable price. But we are not confined to the use of cut stone, for this desirable purpose; stairs may be made of plates of cast iron, supported by wrought iron traverses; of which sort of stairs, a neat specimen has existed for many years, in front of the late Duke of Queensberry's house, in Piccadilly. Stairs of this species, well painted, would look very well, and when carpeted, would scarcely be noticed as extraordinary. A cheaper kind than these might be made from slabs of the large, thick slates, found in Cumberland, sawed out for the purpose, and fastened by screws to wrought iron traverses; these, if carefully made, would also look very well, when painted; and of their strength there could be little doubt, after its having been proved, on good authority, that slate one inch in thickness, will support, in a horizontal position, as much weight as Portland stone, five inches thick, of the same length and breadth. Staircases might also be made, as in France, of a compound nature, of tiles, or thin slabs of stone, plaster, and wood, united; which, though not so good as those mentioned, would, however, be very little, if at all, liable to catch fire, and would be vastly more secure than our deal stairs: small, thin ledges of cast iron, at the projecting angle of each of these stairs, would improve their durability, safety,

and appearance, and would add but little to their cost; and when constructed in this manner, with thin slabs of stone, painted, forming their upper surfaces, might be made to look very handsome. The landing places for these stairs might be made fire-proof in the same manner as the floors of the rooms, and be covered over with slabs of stone, or with tiles, whichever would best correspond with the nature of the stairs.

The floors are evidently of the first importance to be secured from fire, since the fire almost invariably commences with them, when a house is burned down; next to these, the stairs demand attention in this respect, as a means of escape; and after them, the partitions between the rooms should receive notice. These latter should never be made entirely of wood, particularly in rooms where servants sleep; and even lath and plaster partitions, though not so dangerous, ought, however, to be superseded, for greater security, by partitions of four inch brick walls, vulgarly called *brick noggin*, which, in some places, cost less than those last mentioned, and no where much more. Many houses have been burned by servants sticking candles against wooden partitions, which custom, filthy, dangerous, and unpardonable as it is, particularly in houses where candlesticks are in abundance, will still be found practised sometimes even there; and this danger, added to the ready means which they form of conveying the flames from one floor to another, should exclude the use of wooden partitions, and of those of lath and plaster, from all houses desired to be in a state of security against the most tremendous of worldly calamities.

The means pointed out for securing houses against fire, would at least diminish the danger from accidents ninety-nine parts in a hundred; and would even make it extremely difficult for intentional incendiaries to succeed in their diabolical designs; and if not absolutely such as would put them beyond the possibility of conflagration, at least, would render the probability of this dreadful event so very minute, as to place it on a par with the numerous other probabilities, to which our lot, as mortals, subjects us, and which no human prudence can avert. But the pointing out these means, and endeavouring to impress the importance of the subject on the mind and the heart, I am well aware, can but form a small step towards the removal of the evil; and all my hope from doing so, is, that it may engage the attention of the numerous classes who have already suffered from fire, either by the loss of friends, or of property, to induce some of them to unite in the only effectual means for preventing the great frequency of its occurrence.

Those who inhabit houses, seldom have had any concern in building them; and those who build them to let again, merely consider the profit of the speculation, and think the insurance sufficiently covers their part of the risk of fire: and though I think it might be proved to them, that in making houses fire-proof, by the cheap and easy means mentioned, their profits would not be diminished; that the diminution of the value of insurance, which it would soon occasion, would more than counterbalance any small additional expense which

might occur in first bringing it into practice; and that, besides, they would increase their chance of getting a better rent for houses so secured; yet, for many reasons, which must be obvious to those who know the habits and other circumstances of master carpenters, and master bricklayers, of which classes a large majority of builders consists, to attempt to change their methods, in any respect, or even to persuade them that it was possible they were not the best that could be, would be a task no less hopeless than irksome.

Should an act of parliament be passed, compelling, by sufficient penalties, the owners of all houses, the floors of which were not laid before six months after it had obtained the royal assent, to cover the joists of the floors with an adequate coat of plaster, at least as thick as that used for the same purpose in Paris, and prohibiting the use of boards above that coat of plaster, forbidding the construction of wainscot, or wooden partitions, or those of lath and plaster, and enjoining that the stairs should be made fire-proof in some of the modes mentioned, or in some other manner equally safe, it is almost certain, that in fifty or sixty years afterwards, the conflagration of a house in London would be a much more rare occurrence than even in Paris, where it happens so very seldom, notwithstanding the much greater negligence of the people there respecting fire, the greater risk attending some of their methods of cookery, and the increased danger from their using wood for fuel in their apartments.

Of Plasters, or Stuccos, for retaining Water. By M. Hassenfratz.

As cisterns are intended to contain water, the principal condition necessary for the mortar with which they are to be plastered, is, that it should be unattackable by water; it is, therefore, needful, that that these mortars should be good (*betons*) aquadurant cements. Delafaye proposed to form them of one part of lime, slacked dry, and of two parts of chippings of stone, &c. It would appear, that, in pointing out this composition, he has reckoned much on the advantage which dry slacked lime might produce; but what effect would be caused by this method of slacking on rich lime, has been already explained. For the rest, it is extremely easy, as we have observed in treating of *betons*, to procure in every country, excellent mortar for works of this nature. For this purpose, it would be necessary to provide a good lime that hardens in water, either natural or artificial, or to make mortar of rich lime with pozzolana, baked clay, cinders of fossil coal, &c., which will render this lime insoluble in water: finally, in mixing and triturating, with the lime which can be obtained, those substances which will form with it excellent *betons*, it is necessary, farther, to take every precaution, in using these mortars, to favour their setting. For some of these plasters, the cisterns should be speedily filled with water; for some others, it is necessary that the mortar, or *beton*, should be perfectly set, before the intro-

duction of the water. These last *betons*, which require a time, more or less long, to set, or which harden and set at once easily in the air, ought to be preferred; because it is always essential, that the plastering should be completed, before the water is admitted into the reservoir, and that this plaster should take a time, more or less long, before being finished.

While the plaster is exposed to the air, and has not entirely set, it is good to compress, beat, and consolidate it, to prevent crevices being caused by its contraction, and to diminish the bulk caused by its desiccation; it is also no less necessary, to cover it, to prevent its drying too speedily.

At Paris, for a long time, the lime of Senonches was used in the composition of mortars for plastering cisterns, and other reservoirs for water; at present, the artificial lime of M. de Saint Leger, of which we have before written, is preferred; as it hardens more in the water, and costs much less. Besides, in ordering it from M. de Saint Leger, lime hardening (in water) in several different degrees, can be obtained.

If, however, it should be apprehended, that *betons* made with artificial hardening limes would not retain the water powerfully enough, *betons* may be composed with rich lime, and baked clay, in proper proportions, and a little molasses may be also added to the composition.

Of Badigeon, (wash, or thin plaster.)

The name of badigeon, is given to a composition, either white or coloured, which is applied on the exterior surfaces of buildings, and in which lime is commonly the principal substance; it is one of those compositions which are of great solidity, on which paintings in *fresco*, more or less valuable, are executed as upon stucco. Fresco paintings on the front of houses, or of other edifices, are very common in Italy; and some are found there, which are very ancient, and of which the badigeon, or stucco, on which they were executed, must have had a great solidity.

The most simple badigeon, which is most commonly employed, is composed of slaked lime, diluted with water, to which alum or butter-milk is added, and which is laid on the walls with a brush: to this wash of lime and alum, different substances are added, according to the colour which it is required to possess; half a pailful of sawings of stone, with a larger or smaller proportion of street-ochre, are mixed with it, when a stone-colour is desired to be painted; and charcoal-black, or lamp-black, is added, when it is intended to give to the walls the appearance of antiquity, &c. The proportions for a stone-colour, are, a pailful of slaked lime, half a pailful of sawings of stone, and a pound of alum.

In Spain, for a long period, a mixture of serum of blood, and slaked lime, has been employed for colouring the outsides of edifices; this composition adheres firmly, and, when it is dry, resists for a long time the action of water; the serum of ox-blood, alone, decanted immediately after the formation of the coagulum, and applied on soft

stone, gives it a yellowish tinge, and resists water, when it becomes dry. The best manner of employing the serum, is to grind it with roach lime; when this last is slaked, it is passed through a sieve, and a paste is formed with it, which, diluted with serum, and immediately after laid on the stone, covers it very equally, and gives it a yellowish colour, according to the greater or less quantity of colouring particles, which remain in the serum: two coats of this colour are often necessary, and sometimes, three. This paint is neither injured by rubbing, nor by washing with water. This composition has been for a long time used in China. The fixedness of this kind of painting depends on the state of the serum. This substance corrupts so readily, that it must be employed in a day, or, at most, in twenty-four hours, after it is procured; for as soon as the putrid odour becomes perceptible, the painting obtained from it, either separates in scales, or falls off in dust.

For a long time, a white pigment has been used, composed of the caseous part of milk, and lime. M. Bachelier, the son, has announced that his late father employed a similar composition for his preservative badigeon; but the analysis made by Vauquelin, of badigeon, taken from columns, to which it was applied by Bachelier, the father, produced the following result:

Carbonate of lime,	63.00
Sulphate of lime,	7.73
Carbonate of lead,	6.00
Oxide of iron,	4.00
Silex,	2.00
Water,	20.00
	102.73
Organic matter,	an undetermined quantity.

As this analysis did not agree with the composition stated by M. Bachelier, the son, and as it was possible, that in scraping off the badigeon, some of the substance of the pillars (to which it was attached) might have been taken along with it, which would have changed the result that ought to be obtained, M. Guyton collected some badigeon, with which paper was covered, and he found that this, in a dry state, after calcination in a crucible, where it lost 0.18 of its weight, was composed of

Quick lime,	56.66
Baked plaster, (gypsum,)	23.34
Ceruse, or carbonate of lead,	20.00
	100.00

After the great number of researches made on the badigeon of Bachelier, the commissioners named by the Institute to examine it, thus directed the composition, which had succeeded best with them. Slake the lime with the smallest quantity of water possible; pound it along with white cheese, to the consistence of a soft, uniform, and

well-united paste; add to it, baked plaster (gypsum), and ceruse; and by a more exact grinding with water, reduce the whole to the thickness of soup, rather more thick, than thinner; finally, dilute it with common water, at the moment of laying it on, which is usually performed with a varnisher's brush.

It may be perceived, after all the foregoing details, how much there still remains to be done, to obtain exact facts relative to lime stones, their calcination, the goodness and applications of the different species of limes, and, finally, with respect to the composition of mortars, betons, cements, stuccos, and badigeons. We shall find ourselves well rewarded, if this work should excite architects, and men of science, to occupy themselves with these objects, and if their researches should successfully lead them to useful discoveries.

ENGLISH PATENTS.

Specification of the Patent granted to Jean le Grand, *of Lemon street, Goodman's-fields, Middlesex, Vinegar manufacturer, for certain improvements in fermented liquors and the various products to be obtained therefrom. Partly communicated by a foreigner.* Dated January 15, 1824.

The said improvements in the said fermented liquors, and the various products to be obtained therefrom, are as follows. In order to give those wines, and vinegars, which are not obtained from grapes, the qualities which distinguish those made from grapes, I employ the following substances; namely, the tartaric, citric, and oxalic acids, and which I add, either separately, or together, and either in the crystallized state, or diluted with water, to all kinds of fermented worts, wash, or liquors; and either before, during, or after the vinous or acetous fermentations, I likewise mix the said vegetable acids, either singly or together, with all sorts of spirituous liquors, either pure, or diluted with water, or other liquids, with the design of converting those spirits, by acidification, into vinegar, similar to that made from the wine of grapes; or, by distillation or rectification, to convert them into brandy, analogous to that obtained from grapes. I likewise employ the same vegetable acids, by mixing one or more of them with acetic acid, or any kind of vinegar, to increase the strength of those liquids, or to impart to them the qualities of the vinegars obtained from grapes or other fruit.

In witness whereof, &c. [*Rep. Pat. Inventions.*

Patent granted to John Parker, *of Knightsbridge, Middlesex, Iron and Wire Fence Manufacturer, for improvements, or additions, to park, or other gates.* Dated May 23, 1826.

The object of Mr. Parker's "additions" to gates, is to cause them to open on the approach of a carriage, and to close again as soon as

it has passed, without any person being required to assist, directly, in the operation.

The power that produces this effect, is the weight of the carriage, which is made to operate by pressing down, on its passage, an inclined plane, beneath which a bent lever, or crank is placed in a vertical position, on whose inclined arm, an upright piece, connected with the inclined plane, is supported; while the top of its vertical arm is connected by a long bar, with the circumference of a horizontal wheel placed near the gate, the farther side of which, being toothed, turns a horizontal pinion, that is fastened to the bottom of the pivot on which the gate revolves; on the side of the crank next the gate, there is a third arm, in a horizontal position, to the end of which a weight is attached, sufficiently heavy to push the long bar back against the wheel, in the contrary direction to that mentioned, and thereby to shut the gate, after the carriage has passed.

This is the outline of the contrivance, but to carry it into effect, it is also necessary that the gate should be kept open for a certain time, after it is thrown back by the machinery mentioned; that previous to this, it should be freed from the catch which holds it to the gate-post; and lastly, that the parts which hold it open should be removed as soon as the carriage passes, so as to permit the counter-weight to operate in closing the gate again, as at first.

These secondary operations are performed by apparatus of the same kind as that mentioned. Of which that, which raises the catch on the gate-post from the latch, is at the opposite side of the way from the machinery that opens and shuts the gate; while that, which keeps it open and removes the impediments to its being closed, is at the same side. The whole of the parts, that communicate the motion from the moveable inclined planes, to the gate and catches, are placed in long cases or troughs under ground, so that nothing appears above the surface but the inclined planes, the ledges or guides, which confine the wheels of the carriage to the tracks, in which they must encounter these inclined planes, and the thick wires which work the catches.

To hold the gate open, when it is thrown back by the means before explained, there are posts placed at each side of it, in a line with the hinge post, at the same distance from the latter, as the main catch-post; and to each of these posts, catches are attached, of the same nature as the main-catch on the gate post, which catches lay hold of the latch of the gate, and retain it until the wheel of the carriage passes over the inclined plane that works the cranks, which draw down the wires that act on one side of the catches, and elevate them on the other, by turning them round upwards on the hinges that attach them to the posts, out of the way of the latch, (which is of the upright spring kind,) immediately after which, the counterweight operates in closing the gate, and pressing the latch into the main catch on the gate post; which catch, is raised from it, in a similar manner to that described, by inclined planes at the other side of the way, on which the wheel of the carriage acts, a little before it arrives at the principal inclined plane, which opens and shuts the gate.

The cranks by which the catches are moved, have counter-weights to them, as well as those which turn the gate, to bring them to their first positions, and to raise the inclined planes connected with them, so as to be operated on by the pressure of the carriage wheels in passing over them. The gate opens at both sides; and as the apparatus must operate, whichever way the carriage approaches to the gate, in order to be complete, all the parts described are double; or, in other words, a similar apparatus is placed at each side of the gate both for opening and shutting it, and for holding it open and lifting the catches; the inclined planes of which are at sufficient distances from the gate at each side, to allow ample space for the horses in front, so that they shall be entirely out of the way of the movements of the gate.

Lastly, it is mentioned in the specification, that a small vertical roller is placed beneath the rim of the horizontal wheel that acts on the pinion on the pivot of the gate, in order to support it better there against the weight of the ends of the long horizontal bars that connect it with the inclined planes, and thereby enable it to be turned round with more facility. [*ib.*

To EDMUND LLOYD, *of North End, Fulham, in the County of Middlesex, Gentleman, for his Invention of a new apparatus, from which he purposes to feed Fires with coal and other fuel.*

THIS apparatus may be adapted to almost every kind of fire place; it consists of a box or recess, formed behind the grate, a little above the top of the fire, which box or recess is to receive a sufficient quantity of coal or other fuel, to supply the consumption of the fire for a considerable time. The box is to be closed in front by a sliding door, supported by chains passed over pullies, which door being balanced may be readily slidden up, by applying the hand to a small nob, or button, and when the door has been thus raised, the coal may be drawn forward on to the fire.

The weight of the door is proposed to be counterpoised by a loggerhead, or iron ball attached to the end of a lever above, which in its descent draws up the suspending chains, and thereby raises the door with very little labour.

The apparatus may be slightly varied in several ways, still adhering to the principle, which is so simple and obvious, that a representation of the contrivance is not necessary, and indeed its plan of arrangement would require some degree of variation under every change of situation, or circumstance.—Enrolled April, 1825.

[*Newton's Journal.*

To JOHN PHIPPS *of Upper Thames Street, in the City of London, Stationer, and* CHRISTOPHER PHIPPS, *of the Parish of River, in the County of Kent, Paper-maker, for their Invention of an Improvement or Improvements in Machines for Making Paper.*

THIS improvement applies to a certain apparatus, which has been many years in use, denominated "Fourdrinier's patent machine for making paper, of an infinite, or any required length." This machine is so constructed, that the pulp, of which the paper is to be made, flows freely from the vat, on to an endless web of wire-gause, and being there agitated, is caused to settle into a compact consistency. The paper thus made, is then progressively carried forward, by the traversing of the endless web, and passed between squeezing rollers, for the purpose of expressing the water, and is thence conducted, by an endless felt, to the reel, where it is taken up as fast as it becomes formed upon the gause web.

This machine has been heretofore capable of producing only that description of paper, called wove, that is, without lines or water marks: it is therefore the object of the patentees, by their present improvement, to enable the same machine to make what is called laid paper, that is, with lines or water marks.

In order to effect this, they propose to construct a cylinder, the periphery of which shall be made of wire-gause, or the same material that flat paper moulds are usually made of. This cylinder is to be formed by wooden ends, and a series of concentric rings or hoops, having an iron axle through the whole, and the wire-gause to be bound round the periphery of the cylinder, and so neatly joined at the seam, that no junction shall be perceptible. This cylinder is then to be mounted upon the machine, by its pivots falling loosely into slots, or openings, in brass carriages, placed on the side frames of the machine, and the cylinder bearing with considerable weight upon the new formed paper lying upon the endless web, (as described above,) will, by the traversing of the paper, and the web under it, be made to revolve, and the wires upon the periphery of the cylinder, to impress the required lines or water marks into the new formed paper.—Enrolled July, 1825. [*ib.*

To BENJAMIN FARROW, *of Great Tower Street, in the City of London, Ironmonger, for his Invention of an Improvement, or Improvements in Buildings, calculated to render them less likely to be Destroyed or Injured by Fire, than heretofore, which he conceives will be of public utility.*

THIS improvement consists in the employment of wrought iron joists, for supporting the floors and ceilings of houses, instead of wood, as usual, and which joists, by their peculiar form, afford the

means of filling up the interstices between them, with bricks, stones, or other incombustible substances, so as to render the partitions between each floor, perfectly fire-proof.

The joists are each to be made of two flat bars of iron; the edge of one, is to be fastened by means of screws, or rivets, to the middle of the flat side of the other, so that its section will appear in this form. ⊥ The ends of the lower bar, are to be turned down, in order to fix it the more securely into the wall.

When the joists have been thus laid at suitable distances apart, and firmly fixed into the walls of the building, the stone slabs, bricks, tiles, or other materials, of which the floor is to be formed, are placed upon the ledges or rebates of the joists, and are then fastened together with mortar, or Roman cement, which forms a perfectly incombustible partition, between the upper, and lower story.

This contrivance, is designed to supersede the necessity of arching the rafters, which is sometimes practised in constructing fire proof buildings. The stones being made rough on the under side, by pecking, are fit to receive the plaster for ceiling the lower apartment, and the wooden flooring is laid down, on the upper side, by screws passed through the wood into the iron.

Roofs of buildings may be constructed in the same way, by laying the rafters upon a slight inclination, for the purpose of allowing rain water to run off into the gutters.

The rafters have been described as made of two bars of wrought iron, screwed or pinned together, but when employed for small houses, they may be made in one piece, by rolling, in the way bars and rods of iron are commonly formed at the iron works.—Enrolled August, 1825. [*Rep. Pat. Inventions.*

Patent granted to William Hirst, *of Leeds, County of York, Cloth Manufacturer, for improvements in spinning, and stubbing machines.* Dated Jan. 11, 1825.

Mr. Hirst's improvements, (which, though intended for machines for spinning wool, may be extended to those for cotton, and other fibrous substances,) consist in having a double number of spindles in each machine, by placing a second row behind the first, so that each spindle in it shall be opposite to the interval between two of those in the first row, and by making the following alterations in and additions to some other parts of the machines, which this change renders necessary. First, as the number of threads is twice as great as before, the number of robings must be increased in the same proportion, which is effected by adding two more "creels," or rows of robings, one above and the other below the two rows of the original machine. Secondly, the fluted rollers, which in the common machines are divided into separate bosses for each thread, with vacant spaces between them, are in Mr. Hirst's machines made continuous without any separations; to enable them to act on the double number of threads, which are to pass over them. And, lastly, the additional

bands necessary for the increased number of spindles, are made to fall in on the vertical drums by which they are turned in the machines, by fixing on them the "warls," or whirls, of the new spindles at elevations different from those of the primary row, so that the bands may move in separate horizontal planes, in such a manner as to avoid all contact and interference with each other.

These improvements of Mr. Hirst's are of that simple species, the advantage of which is so very apparent, as to create some degree of surprise, that they have not been before adopted. They appear to us to be particularly beneficial, in such places where rents of buildings are high, as they cause the new machines to do twice the quantity of work, without occupying any more space than the old machines; and, moreover, have the farther advantage of requiring no additional expense in mill machinery, framing, or the wheel work of the separate machines, than is necessary for the original machines, which only performed half the work.

It seems probable, that the principle adopted on this occasion may be farther extended, by using three or more rows of spindles, in such machines, in place of the original single row; the only limits to this plan appearing to be the number of threads, that can be made to lie on the fluted rollers, without becoming entangled by their projecting fibres. It is true that even these limits seem capable of being enlarged, by having a second row of fluted rollers; but we doubt very much whether the difficulty of piecing the broken threads, and the other embarrassments, which the crowded state of the work, caused by this latter arrangement, might occasion, would not more than counterbalance any benefit, that might be obtained by its adoption.

[*ib.*

The Marquis of Worcester, and the 'CENTURY OF INVENTIONS.'

It has been suggested to us, that a republication of the Marquis of Worcester's Century of Inventions, would be generally acceptable. With a view to comply with this suggestion, we applied for the copy of the work in the Philadelphia Library, and were gratified by finding one of the first impressions of the book, published in the year 1663.

The first edition of the "Century," is very rare, and it may well be so, if the account given by Desaguliers be correct. He states that captain Savary, to conceal the fact of his having derived from this book, the information which led to the construction of his steam engine, purchased up all the copies he could find, and burned them.

The circumstance which has given to this work its greatest celebrity, is the generally acknowledged fact, that it contains, in article 68, the first account of the application of steam, to the raising of water in large quantity, and to a considerable height. Some, it is true, have attempted to deprive the author of this honour, and have cited the contrivances of De Caus, Branca, and some others; these, however, were but ingenious toys, and will scarcely be admitted to interfere with the claims of the marquis of Worcester.

Some of the projects, mentioned in the "Century," are altogether absurd, being contrary to the established laws of nature; it must be recollected, however, that the work before us, was not designed to satisfy inquiry, but to excite surprise, and that the whole is therefore written in a style of mystery and enigma: several of the propositions which were formerly deemed impracticable, no longer stand in this predicament, as they have been carried into effect, in a way which fully justifies the account given by the marquis, and in the whole number, there are but few which a competent judge would pronounce to be impossible.

The editor of the London Mechanics' Magazine, compared a good printed copy of the "Century" with a MS. in the hand writing of the marquis himself, which is preserved in the British museum; and has, in his republication of it, given the variations in this MS. in the foot notes. They are in general immaterial; in one instance, however, the MS. has substituted quite a different invention, for that in the printed copy: this is in No. 88.

The following account of the marquis, together with the variations above noticed, we copy from the Mechanics' Magazine; and shall add, from the same source, a very interesting article, intended to prove that the marquis actually constructed and applied the steam engine to practical purposes. EDITOR.

The author of this singular production, of whom our readers may not be displeased to know, previously, some particulars, was one of the most remarkable political characters of his age. He was "the famous earl of Glamorgan, so created by Charles the First while heir-apparent to the marquis of Worcester. He was a bigoted Catholic, but in times when that was no disrecommendation, and when it grew a merit. Being of a nature extremely enterprising, and a warm loyalist, he was despatched into Ireland by the king. Here history lays its finger, at least is interrupted by controversy. The censurers of king Charles charge that prince with sending this lord to negotiate with the Irish rebel Catholics, and to bring over a great body of them for the king's service. The devotees of Charles would disculpate him, and accuse the lord Glamorgan of forging powers from the king for that purpose. The fact stands thus: the treaty was discovered, the earl was imprisoned by the king's servants in Ireland, and was dismissed by them, unpunished, before the king's pleasure was known. The parliament complained; the king disavowed the earl, yet renewed his confidence in him; nor did the earl ever seem to resent the king's disavowal, which, with much good nature, he imputed to the necessities of his majesty's affairs."*

The king, "with all his affection for the earl, in one or two letters to others, mentions his want of judgment. Perhaps his majesty was glad to trust to his indiscretion. With *that* his lordship seems [to have been] greatly furnished. We find him taking oaths upon oaths to the pope's nuncio, with promises of unlimited obedience both to

* Walpole's Royal and Noble Authors.

his holiness and to his delegate, and begging five hundred pounds of the Irish clergy, to enable him to embark and fetch fifty thousand pounds—like an alchemist, who demands a trifle of money, for the secret of making gold. In another letter he promises two hundred thousand crowns, ten thousand arms for foot, two thousand cases of pistols, eight hundred barrels of powder, and thirty or forty well provided ships!! when he had not a groat in his purse, or as much gunpowder as would scare a corbie! It is certain that he and his father wasted an immense sum in the king's cause; of all which merits and zeal his majesty was so sensible, that he gave the earl the most extraordinary patent, perhaps, that ever was granted; the chief powers of which were to make him generalissimo of three armies, and admiral, with nomination of his officers, to enable him to raise money by selling his majesty's woods, wardships, customs and prerogatives, and to create, by blank patents, to be filled up at Glamorgan's pleasure, from the rank of baronet to that of marquis. If any thing could justify the delegation of such authority, besides his majesty having lost all authority when he conferred it, it was the promise with which the king concluded, of bestowing the princess Elizabeth on Glamorgan's son. It was time to adopt into his family, when he had into his sovereignty. This patent, the marquis, after the restoration, gave up to the house of peers. He did not long survive that era, dying in 1667."*

The marquis's Century of Inventions, which we are now to lay before our readers, was first printed in 12mo., in 1683.† Walpole is pleased to designate it as an "amazing piece of folly;" but later and better informed writers have been led to think differently of it. Granger remarks—"That a practical mathematician, who has quickness to seize a hint and sagacity to apply it, might avail himself greatly of these scantlings, though little more than a bare catalogue." And the same writer was informed by the late reverend and ingenious mechanic, Mr. Gainsborough, of Henley, brother to the celebrated painter, that the marquis's work was far from being such a collection of whims and chimeras as it has been supposed to be, and that, on the contrary, "he highly esteemed the author as one of the greatest mechanical geniuses that ever appeared in the world." It is quite certain, too, that since his time several of his "inventions" or suggestions have been reduced to practice; and hence the whole have become entitled to be treated with more respect. Professor Robison goes so far even as to affirm, that the steam-engine, the greatest discovery of modern times, "was, beyond all doubt, invented by the marquis;" and though later researches have shown that this is somewhat unmerited praise, it is evident that he entertained views of the applicability of steam as a moving power, such as no other individual of the age in which he lived had the sagacity to embrace.

The "book" which he promises, at the conclusion of the century, to leave to posterity, showing "the means to put in execution and visible trial, all, and every of these inventions, with the shape and

* Walpole.

† This is a mistake, the copy before us is in 24mo., and dated in 1663. [*Editor Franklin Journal.*

form of all things belonging to them,—printed by brass plates," he did not live to execute.

A CENTURY OF THE NAMES AND SCANTLINGS OF SUCH INVENTIONS AS AT PRESENT I CAN CALL TO MIND TO HAVE TRIED AND PERFECTED, WHICH (MY FORMER NOTES BEING LOST) I HAVE, AT THE INSTANCE OF A POWERFUL FRIEND, ENDEAVOURED NOW, IN THE YEAR 1655, TO SET THESE DOWN IN SUCH A WAY AS MAY SUFFICIENTLY INSTRUCT ME TO PUT ANY OF THEM IN PRACTICE.

"Artis, et Naturæ proles."

LONDON, printed by *J. Grismond*, in the year 1663.

To the King's Most Excellent Majesty.

SIR—"*Scire meum nihil est, nisi me scire hoc sciat alter,*" saith the poet, and I must justly, in order to your majesty, whose satisfaction is my happiness, and whom to serve is my only aim, placing therein my *summum bonum* in this world: be, therefore, pleased to cast your gracious eye over this summary collection, and then to pick and choose. I confess I made it but for the superficial satisfaction of a friend's curiosity, according as it is set down; and if it might now serve to give aim to your majesty how to make use of my poor endeavours, it would crown my thoughts, who am neither covetous nor ambitious but of deserving your majesty's favour, upon my own cost and charges; yet, according to the old English proverb, *It is a poor dog not worth whistling after.* Let but your majesty approve, and I will effectually perform to the height of my undertaking: vouchsafe but to command, and with my life and fortune I shall cheerfully obey, and, *maugre* envy, ignorance, and malice, ever appear your majesty's passionately devoted, or, otherwise, disinterested subject and servant, WORCESTER.

To the right honourable the lords spiritual and temporal, and to the knights, citizens, and burgesses of the honourable house of commons, now assembled in parliament.

My lords and gentlemen—Be not startled if I address to all, and every of you, this century of summary heads of wonderful things, even after the dedication of them to his most excellent majesty, since it is with his most gracious and particular consent, as well as indeed no ways derogating from my duty to his sacred self, but rather in further order unto it, since your lordships, who are his great council, and you, gentlemen, his whole kingdom's representatives (most worthily welcome unto him,) may fitly receive into your wise and serious considerations what doth or may publicly concern both his majesty and his tenderly beloved people.

Pardon me if I say (my lords and gentlemen) that it is jointly your parts to digest, to his hand, these ensuing particulars, fitting

them to his palate, and ordering how to reduce them into practice in a way useful and beneficial both to his majesty and his kingdom.

Neither do I esteem it less proper for me to present them to you, in order to his majesty's service, than it is to give into the hands of a faithful and provident steward whatsoever dainties and provisions are intended for the master's diet; the knowing and faithful steward being best able to make use thereof to his master's contentment and greatest profit, keeping for the morrow whatever should be overplus or needless for the present day, or, at least, to save something else in lieu thereof. In a word, (my lords and gentlemen,) I humbly conceive this simile not improper, since you are his majesty's provident stewards, into whose hands I commit myself with all properties fit to obey you, that is to say, with a heart harbouring no ambition, but an endless aim to serve my king and country; and if my endeavours prove effectual, (as I am confident they will,) his majesty shall not only become rich, but his people likewise as treasurers unto him; and his peerless majesty, our king, shall become both beloved at home and feared abroad, deeming the riches of a king to consist in the plenty enjoyed by his people.

And the way to render him to be feared abroad is, to content his people at home, who then, with heart and hand, are ready to assist him; and whatsoever God blesseth me with to contribute towards the increase of his revenues in any considerable way, I desire it may be employed to the use of his people; that is, for the taking off such taxes or burthens from them as they chiefly groan under, and by a temporary necessity only imposed upon them, which, being thus supplied, will certainly best content the king and satisfy his people, which, I dare say, is the continual tend of all your indefatigable pains, and the perfect demonstrations of your zeal to his majesty, and an evidence that the kingdom's trust is justly and deservedly reposed in you. And if ever parliament acquitted themselves thereof, it is this of yours, composed of most deserving and qualified persons—qualified, I say, with your affection to your prince, and with a tenderness to his people; with a bountiful heart towards him, yet a frugality in their behalf.

Go on, therefore, cheerfully (my lords and gentlemen,) and not only our gracious king, but the King of kings, will reward you; the prayers of the people will attend you; and his majesty will, with thankful arms, embrace you. And be pleased to make use of me and my endeavours to enrich them, not myself. Such being my only request unto you, spare me not in what your wisdom shall find me useful, who do esteem myself, not only by the act of the water-commanding engine (which so cheerfully you have past,) sufficiently rewarded, but likewise with courage enabled to do ten times more for the future; and my debts being paid, and a competency to live according to my birth and quality settled, the rest shall I dedicate to the service of our king and country by your disposals; and esteem me not the more, or, rather, any more, by what is past, but what is to come; professing really, from my heart, that my intentions are to outgo the six or seven hundred thousand pounds already sacrificed, if

countenanced and encouraged by you, ingenuously confessing that the melancholy which hath lately seized upon me (the cause whereof none of you but may easily guess) hath, I dare say, retarded more advantages to the public service than modesty will permit me to utter; and now, revived by your promising favours, I shall infallibly be enabled thereunto in the experiments extant and comprised under these heads, practicable with my directions by the unparallelled workman, both for trust and skill, *Caspar Kaltoff's* hand, who hath been these five and thirty years as in a school, under me employed, and still at my disposal, in a place by my great expenses made fit for public service, yet lately like to be taken from me, and consequently from the service of king and kingdom, without the least regard of about ten thousand pounds expended by me, and through my zeal, to the common good; my zeal, I say, a field large enough for you (my lords and gentlemen) to work upon.

The treasures buried under these heads, both for war, peace and pleasure, being inexhaustible, I beseech you pardon me if I say so. It seems a vanity, but it comprehends a truth, since no good spring but becomes the more plentiful by how much more it is drawn, and the spinner to weave his web is never stinted but further inforced.

The more then that you shall be pleased to make use of my inventions, the more inventive shall you ever find me; one invention begetting still another, and more and more improving my ability to serve my king and you; and as to my heartiness therein, there needs no addition, nor to my readiness a spur. And therefore (my lords and gentlemen) be pleased to begin, and desist not from commanding me till I flag in my obedience and endeavours to serve my king and country:

> For certainly you'll find me breathless first t'expire,
> Before my hands grow weary, or my legs do tire.

Yet, abstracting from any interest of my own, but as a fellow-subject and compatriot, will I ever labour in the vineyard, most heartily and readily obeying the least summons from you, by putting faithfully in execution, what your judgments shall think fit to pitch upon, amongst this century of experiences, perhaps dearly purchased by me, but now frankly, and *gratis*, offered to you. Since my heart (methinks) cannot be satisfied in serving my king and country, if it should cost them any thing, as I confess, when I had the honour to be near so obliging a master, as his late majesty, of happy memory, who never refused me his ear to any reasonable motion; and as for unreasonable ones, or such as were not fitting for him to grant, I would rather to have died a thousand deaths, than ever to have made any one unto him.

Yet, whatever I was so happy as to obtain for any deserving person, my pains, breath, and interest, employed therein, satisfied me not, unless I likewise satisfied the fees; but that was in my golden age. And even now, though my ability and means are shortened, (the world knows why,) my heart remains still the same; and be you pleased, my lords and gentlemen, to rest most assured, that the very

complacency that I shall take in the executing your commands, shall be unto me a sufficient and an abundantly satisfactory reward.

Vouchsafe, therefore, to dispose freely of me, and whatever lieth in my power to perform—first, in order to his majesty's service; secondly, for the good and advantage of the kingdom; thirdly, to all your satisfactions, for particular profit and pleasure to your individual selves: professing that, in all and each of the three respects, I will ever demean myself as it best becomes, my lords and gentlemen, your most passionately bent fellow-subject in his majesty's service, compatriot for the public good and advantage, and a most humble servant to all and every of you, WORCESTER.

A Century of the names and scantlings of Inventions by me already practised.

1. Several sorts of seals, some showing by screws, others by gages fastening or unfastening all the marks at once, others by additional points and imaginary places, proportionable to ordinary escutcheons and seals at arms, each way palpably and punctually setting down (yet private from all others, but the owner, and by his assent,) the day of the month, the day of the week, the month of the year, the year of our Lord, the names of the witnesses, and the individual place where any thing was sealed, though in ten thousand several places, together with the very number of lines contained in a contract, whereby falsification may be discovered, and manifestly proved, being upon good grounds suspected.

Upon any of these seals, a man may keep accounts of receipts and disbursements, from one farthing to a hundred millions, punctually showing each pound, shilling, penny, or farthing.

By these seals, likewise, any letter, though written but in English, may be read and understood in eight several languages, and in English itself to clean contrary and different sense, unknown to any but the correspondent, and not to be read or understood by him neither, if opened before it arrive unto him; so that neither threats, nor hopes of reward, can make him reveal the secret, the letter having been intercepted, and first opened by the enemy.

2. How ten thousand persons may use these seals to all and every of the purposes aforesaid, and yet keep their secrets from any but whom they please.

3. A cipher and character, so contrived, that one line, without returns and circumflexes, stands for each and every of the twenty-four letters, and as ready to be made for the one letter as the other.

4. This invention, refined, and so abbreviated, that a point only showeth distinctly and significantly any of the twenty-four letters, and these very points to be made with two pens; so that no time will be lost, but as one finger riseth, the other may make the following letter, never clogging the memory with several figures, for words and combinations of letters, which, with ease, and void of confusion, are thus speedily and punctually, letter for letter, set down by naked, and not multiplied points. And nothing can be less than a point, the

mathematical definition of it, being *cujus pars nulla*. And of a motion, no swifter imaginable, than semiquavers, or releshes; yet applicable to this manner of writing.

5. A way, by a circular motion, either along a rule, or ringwise, to vary any alphabet, even this of points, so that the self-same point, individually placed, without the least additional mark, or variation of place, shall stand for all the twenty-four letters, and not for the same letter twice in ten sheets' writing; yet, as easily and certainly read and known, as if it stood but for one and the self-same letter, constantly signified.

6. How, at a window, as far as eye can discover black from white, a man may hold discourse with his correspondent, without noise made, or notice taken; being, according to occasion given, and means afforded, *ex re nata*, and no need of provision beforehand; though much better if foreseen, and means prepared for it, and a premeditated course taken, by mutual consent of parties.

7. A way to do it by night, as well as by day, though as dark as pitch is black.

8. A way how to level and shoot cannon, by night, as well as by day, and as directly, without a platform, or measures taken by day, yet by a plain and infallible rule.

9. An engine, portable in one's pocket, which may be carried and fastened on the inside of the greatest ship, *tanquam aliud agens*, and, at any appointed minute, though a week after, either of day or night, it shall irrecoverably sink that ship.

10. A way, from a mile off, to dive, and fasten a like engine to any ship, so as it may punctually work the same effect, either for time or execution.

11. How to prevent and safeguard any ship from such an attempt, by day or night.

12. A way to make a ship not possible to be sunk, though shot a hundred times betwixt wind and water, by cannon, and should lose a whole plank; yet, in half an hour's time, should be made as fit to sail as before.

13. How to make such false decks as, in a moment, should kill, and take prisoners, as many as should board the ship, without blowing the decks up, or destroying them, from being reducible; and, in a quarter of an hour's time, should recover their former shape, and to be made fit for any employment, without discovering the secret.

14. How to bring a force, to weigh up an anchor, or to do any forcible exploit, in the narrowest or lowest room in any ship, where few hands shall do the work of many; and many hands applicable to the same force, some standing, others sitting, and, by virtue of their several helps, a great force augmented in little room, as effectual as if there were sufficient space to go about with an axletree, and work far from the centre.

15. A way how to make a boat work itself against wind and tide, yea, both, without the help of man or beast; yet so that the wind, or tide, though directly opposite, shall force the ship, or boat, against itself, and in no point of the compass, but it shall be as effectual as if the

wind were in the *poop*, or the stream actually with the course it is to steer, according to which the oars shall row, and necessary motions work and move, towards the desired port, or point of the compass.

16. How to make a sea-castle, or fortification, cannon-proof, and capable of containing a thousand men; yet sailable at pleasure to defend a passage; or, in an hour's time, to divide itself into three ships, as fit and trimmed to sail as before; and even whilst it is a fort, or castle, they shall be unanimously steered, and effectually be driven, by an indifferent strong wind.

17. How to make upon the Thames, a floating garden of pleasure, with trees, flowers, banqueting-houses, and fountains, stews for all kinds of fishes, a reserve for snow, to keep wine in, delicate bathing-places, and the like; with music, made with* mills, and all in the midst of the stream, where it is most rapid.

18. An artificial fountain, to be turned, like an hour-glass, by a child, in the twinkling of an eye; it holding a great quantity of water, and of force sufficient to make snow, ice, and thunder; with a chirping and singing of birds, and showing of several shapes and effects, usual to fountains of pleasure.

19. A little engine, within a coach, whereby a child may stop it, and secure all persons within it, and the coachman himself, though the horses be never so unruly in a full career; a child being sufficiently capable to loosen them, in what posture soever they should have put themselves, turning never so short, for a child can do it in the twinkling of an eye.

20. How to bring up water, balancewise, so that as little weight, or force, as will turn a balance, will be only needful, more than the weight of the water within the buckets, which, counterpoised, empty† themselves, one into the other, the uppermost yielding its water (how great a quantity soever it holds) at the self-same time the lowermost taketh it in, though it be a hundred fathom high.

21. How to raise water constantly with two buckets only, day and night, without any other force than its own motion, using not so much as any force, wheel, or sucker, nor more pulleys than one, on which the cord, or chain, rolleth, with a bucket fastened at each end. This, I confess, I have seen and learned of the great mathematician, Claudius,‡ his Studies at Rome, he having made a present thereof unto a cardinal; and I desire not to own any other men's inventions, but if I set down any, to nominate likewise the inventor.

22. To make a river in a garden to ebb and flow constantly, though twenty feet over, with a child's force, in some private room, or place, out of sight, and a competent distance from it.

23. To set a clock in‖ a castle, the water filling the trenches about it; it shall show, by ebbing and flowing, the hours, minutes, and seconds, and all the comprehensible motions of the heavens, and counterlibration of the earth, according to Copernicus.

* "By," MS. copy.

† "Counterpoised and empty."

‡ "Clavius."

‖ "As within."

24. How to increase the strength of a spring to such a height, as to shoot bumbasses and bullets of a hundred pounds weight, a steeple height, and a quarter of a mile off, and more, stone-bowwise; admirable for fire-works, and astonishing of besieged cities, when, without warning given by noise, they find themselves so forcibly and dangerously surprised.

25. How to make a weight that cannot take up a hundred pounds, and yet shall take up two hundred pounds, and at the self-same distance from the centre; and so, proportionably, to millions of pounds.

26. To raise weight as well and as forcibly with the drawing back of the lever, as with the thrusting it forwards; and, by that means, to lose no time, in motion, or strength. This I saw in the arsenal at Venice.

27. A way to move to and fro, huge weights, with a most inconsiderable strength, from place to place. For example, ten ton with ten pounds, and less; the said ten pounds not to fall lower than it makes the ten ton to advance, or retreat, upon a level.

28. A bridge, portable in* a cart, with six horses, which, in a few hours' time, may be placed over a river half a mile broad, whereon, with much expedition, may be transported horse, foot, and cannon.

29. A portable fortification, able to contain five hundred fighting men; and yet, in six hours time, may be set up, and made cannon-proof, upon the side of a river, or pass, with cannon mounted upon it, and as complete as a regular fortification, with half-moons and counterscarps.

30. A way, in one night's time, to raise a bulwark, twenty or thirty feet high, cannon-proof, and cannon mounted upon it, with men to overlook, command, and batter a town; for though it contain but four pieces, they shall be able to discharge two hundred bullets each hour.

31. A way how, safely and speedily, to make an approach to a castle, or town wall, and over the very ditch, at noon-day.

32. How to compose a universal character, methodical, and easy to be written, yet intelligible in any language; so that, if an Englishman write it in English, a Frenchman, Italian, Spaniard, Irish, Welch, being scholars, yea, Grecian, or Hebritian, shall as perfectly understand it in their own tongue, as if they were perfect English, distinguishing the verbs from nouns, the numbers, tenses, and cases, as properly expressed in their own language as it was written in English.

33. To write with a needle and thread, white, or any colour, upon white, or any other colour, so that one stitch shall significantly show any letter, and as readily and as easily show the one letter as the other, and fit for any language.

34. To write by a knotted silk string, so that every knot shall signify any letter, with comma, full point, or interrogation, and as legible as with pen and ink upon white paper.

35. The like, by the fringe of gloves.

* "Upon."

36. By stringing of bracelets.
37. By pink'd gloves.
38. By holes in the bottom of a sieve.
39. By a lattin, or plate lanthorn.*
40. By the smell.
41. By the taste.
42. By the touch.

By these three senses, as perfectly, distinctly, and unconfusedly, yea, as readily, as by the sight.

43. How to vary each of these, so that ten thousand may know them, and yet keep the understanding part from any but their correspondent.

44. To make a key of a chamber-door, which, to your sight, hath its wards and rosepipe but paper thick, and yet, at pleasure, in a minute of an hour, shall become a perfect pistol, capable to shoot through a breast-plate commonly of carabine-proof, with prime, powder, and fire-lock, undiscoverable in a stranger's hand.

45. How to light a fire and candle, at what hour in the night one waketh, without rising, or putting one's hand out of the bed. And the same thing becomest a serviceable pistol, at pleasure; yet, by a stranger, not knowing the secret, seemeth but a dexterous tinder-box.

46. How to make an artificial bird, to fly which way, and as long, as one pleaseth, by or against the wind, sometimes chirping, other times hovering, still tending the way it is designed for.

47. To make a ball of any metal, which, thrown into a pool or pail of water, shall presently rise from the bottom, and constantly show, by the superficies of the water, the hour of the day, or night, never rising more out of the water than just to the minute it showeth of each quarter of the hour; and if by force kept under water, yet the time is not lost, but recovered, as soon as it is permitted to rise to the superficies of the water.

48. A screwed ascent, instead of stairs, with fit landing-places to the best chambers of each story, with back stairs within the newel of it, convenient for servants to pass up and down to the inward rooms of them, unseen and private.

49. A portable engine, in the way of a tobacco-tongs, whereby a man may get over a wall, or get up again, being come down, finding the coast proving insecure to him.

50. A complete, light, portable ladder, which, taken out of one's pocket, may be, by himself, fastened a hundred feet high, to get up by, from the ground.

(TO BE CONTINUED.)

* "Candlestick lanthorn."   † "To be."

Experiments on the Action of Water upon Glass, with some Observations on its slow Decomposition. By Mr. T. Griffiths, *Chemical Assistant in the Laboratory of the Royal Institution.*

It is a commonly received notion, that glass is capable of resisting, to a very great extent, the attacks of active chemical solvents, and that its alkali can neither be readily separated, nor exhibited, in an insulated form, without regularly submitting it to powerful decomposing agents. Speaking of glass, in common language, without any reference to the many soluble compounds so designated, it may be a new fact in chemistry, to prove that this singular substance possesses highly alkaline properties, which may easily be shown by the usual tests.

Upon reducing some thick flint-glass to a moderately fine powder in an earthenware mortar, for the purpose of analysis, a portion of it was placed on turmeric paper, with a view of determining if it possessed any sensible alkaline property; and, upon being moistened with water, the yellow colour of the test-paper was instantly reddened, nearly as powerfully as if lime had been employed. This effect was considered as accidental, and as probably arising from some adventitious alkaline matter, or soap, adhering to the vessels employed. Another experiment was made, with greater care, in an agate-mortar, but with the same, or even a more decided result, in consequence of the more minute division of the material. When pulverized on perfectly clear, and polished surfaces of iron, steel, zinc, copper, silver and platinum, the effect took place, and apparently, with great facility; but it was found that the presence of small quantities of oxide of iron, greatly diminished it; in consequence, as was afterwards proved, of the particles of glass being by them defended from the contact of water.

Since there are some saline bodies, and metallic combinations, which give indications of alkali to turmeric paper, although perfectly neutral compounds, and as pure magnesia reddens this paper when moistened with water, although no solution can be shown to take place, possibly this might be an effect of the kind, it scarcely appearing probable that any soluble matter should be abstracted from the powdered glass by the mere effusion of pure water. Litmus paper, therefore, reddened by an acid, and paper stained with the blue infusion of cabbage, were also employed as tests; the former had its blue colour restored, and the latter was rendered green.

A portion of flint-glass, in fine powder, was boiled in water for some hours; upon being allowed to cool and subside, the clear portion was decanted and evaporated, and became strongly alkaline to the taste, and to other usual tests; a drop of its concentrated solution, gradually evaporated on a glass-plate, on exposure to the atmosphere, in a short time became deliquescent. Tartaric acid produced an effervescence, and afterwards a precipitate in this solution; as likewise did muriate of platinum. From these experiments, therefore, it may be fairly inferred, that the alkali removed from the glass, was

potash in an uncombined state, and that the alkaline effect, obtained in the first instance, did not depend upon the presence of any alkaline salts, or combination, adhering to, or diffused throughout the glass. The remaining sediment from the above solution, after having been repeatedly washed in successive portions of water, became inert, as to its action on test papers, not affecting their colours, in the slightest degree; but upon *trituration* its alkaline power was again developed; this property being evidently dependent upon the exposure of a new, or undecomposed surface. A slight application of heat to the water, was found greatly to facilitate this evolution of alkali.

In order to determine the quantity of alkaline matter abstracted from a given weight of glass, by long and continued boiling, 100 grains of flint-glass, in fine powder, were boiled nearly every day for some weeks, in two or three successive portions of water; after this process, the insoluble residue was found deficient in weight by nearly seven grains. This result, however, must not be considered as accurate, but as a mere approximation: for on the one hand, small portions of glass might have been carried away in the supernatant liquor; and on the other, more alkali might have been abstracted by repeatedly triturating during the process, which, under these circumstances, would be almost unlimited.

To some pure, dilute, muriatic acid, was added very fine flint-glass in powder, till it was completely neutralized, by its alkaline effect. Upon being allowed to subside, (which, however, was not very readily effected, minute particles remaining suspended for weeks together,) the clear portion afforded a crystalline salt on evaporation, having the characters of muriate of potash.

It may be remarked, that this solution, when *perfectly clear*, contained no lead, on testing for it by sulphuretted hydrogen; but upon agitating, or diffusing the fine powder of glass through water, holding the gas in solution, it was immediately discoloured, or blackened.

Flint-glass, although chosen for the above experiments, is not the only variety, possessing this remarkable property; crown, and plate glass, white enamel, and, what is more remarkable, Newcastle, green bottle glass, and tube of the same material (in the composition of which there is, comparatively, little alkali,) also Reaumur's porcelain, made from the green bottle glass, possess the power of acting upon vegetable colours, as alkalies.

These experiments, tending to prove that glass is a body of irregular composition, parting readily with its alkali by the action of water, it became a matter of some interest, to determine how far certain natural combinations of potash with siliceous matter, were equally active to the same tests, especially as in green bottle glass, which contains little alkali, it is thus rendered evident. No analogous effect could, however, be produced by powders of felspar, basalt, greenstone, granite, obsidian, pumice, and some others, even when boiled with water, a method which never failed to produce it rapidly with glass, although cold water is perfectly sufficient.

Some interesting conclusions may be drawn from the above experiments, which may tend to explain some well known phenomena.

In the first place, with regard to the glasses employed, in the laboratory, or for domestic uses, it must be evident that water has the power of acting upon, and dissolving, the alkali at the surface, and leaving an insoluble portion, spread as a coating over the interior of the vessel, defending it from further immediate action.

Where, however, time can be allowed, the effect does not appear to be confined to mere surface. In collections of ancient glass, specimens may be selected, exhibiting how extensively an analogous action has been going on during the period they have remained buried in the earth. These vitreous relics of antiquity are often covered to a considerable thickness, with opal pearly scales of beautiful appearance, consisting, almost wholly, of silica, whose alkali had been removed, probably, by the action of water.*

A fragment of transparent ancient glass was examined with regard to its alkaline property, which it was found to enjoy in a high degree, being sensibly alkaline (when in powder,) to the tongue, and its hot solution acting upon the cuticle. It appeared to consist, almost entirely, of potash and silica; not the smallest trace of lead being discoverable in it; several other coloured specimens of ancient glass, upon examination, were, in every case, more highly alkaline than any modern glass containing lead, that has hitherto been examined.

The specific gravity of common flint-glass was taken, by way of comparison with the ancient fragments, above mentioned, the result of which is here given. Flint-glass, *s. g.*, 3.208. Ancient glass, 2.375. It may here be remarked, that the latter acted powerfully upon the test-paper, by merely moistening it, without reduction to powder. It cannot be surprising, therefore, that ancient glass, which may almost be called pure silicate of potash, should be occasionally found in states of such rapid decay, as the specimens in collections often exhibit.

Another proof of the action of water, aided by other concomitant circumstances, in producing decomposition upon glass, is an account given in vol. i. p. 135, of the Quarterly Journal of Science, of some bottles of wine, found in a quantity of black mud at the bottom of an old well, full of burned wood, supposed, upon good authority, to be of anterior date to the fire of London, (1666.)

The siliceous earth, in this instance, separated in films on the surface of the bottle, in consequence of the abstraction of alkaline matter, probably by the action of water, aided perhaps, originally, by a certain degree of heat, and afterwards, by the long period of their continuance, in a situation favourable to the decomposing agency.

In contact with ammoniacal, or decomposing animal matter, the disintegration of glass takes place more rapidly. Stable windows, and bottles kept in such situations, often present a very beautiful iridescent appearance, in consequence of the siliceous matter being

* The opal is a hydrate of silica. May not its formation have taken place by a similar agency acting upon natural combinations? The removal of alkali from siliceous compounds, may have left opal thus constituted.

developed in thin plates on its surface, often amounting to a pearly, and sometimes almost metallic appearance; an effect which, it is believed, has not been hitherto investigated.

Solution of potash acts very rapidly upon glass, as the chemist, often, inconveniently, learns by the effect produced upon the bulb of a thermometer employed to determine its boiling point, and which is always found corroded to a considerable extent after the experiment.

It may also here be remarked, (although not perhaps immediately connected with the subject,) that from frequent observations of a person, in the habit of using solid carbonate of ammonia, the flint-glass bottles in which it has been for some time kept, are invariably rendered much more brittle, and pieces of glass fall out upon very slight motion of its contents. This fact is merely mentioned as curious, and may, probably, be hereafter more fully examined.

[*Journal of the Royal Institution.*

ESSAYS ON BLEACHING.

By James Rennie, A. M. Lecturer on Philosophy, &c. &c. London.

No. III.—CHEMICAL AGENTS USED IN BLEACHING.

Section III.—*Of the Mineral Alkali.*

Soda is procured in a similar manner with potash, by incineration, and afterwards lixiviating; but from vegetables of a very different habitat. Potash is manufactured chiefly from trees; while soda, when it is procured from vegetables, is made exclusively from marine plants. Sometimes it is found native, as in Russia, and in Egypt, where it is called natron. But, however much it may differ from potash, in its appearance, and in the plants whence it is obtained, when used as an agent in bleaching, there is little difference in its effects, provided that the strength of the ley, and other circumstances, shall be equal. Hitherto, the exorbitant price of this commodity has excluded it from being used in the bleach-field; but as more economical modes are now contrived, and as it is made of great purity, there is little doubt that it will now soon be introduced, particularly as it is admirably calculated for the finishing process of the finer fabrics of muslin. Ramsay, from whom I take these remarks, adds, that six ounces of pure carbonate of soda, with ten ounces of soap, produce detergent effects equal to a pound and a half of soap used alone. The oxymuriate of soda, as will afterwards be detailed, is sometimes used in calico bleaching, and must require this alkali in a crude state, for its manufacture.

Barilla is obtained chiefly on the shores of the Mediterranean, from the salsola kali, the salicornia, and the chænopodia of Linnæus, which are dried to the same degree as hay, and burned in pits, like those used with us for kelp, which reduces them to a grayish-blue

mass, containing more or less mineral alkali. When broken, it presents a blackish fracture. It usually contains from 20 to 24 per cent. of pure alkali; but the superior sort of it, called sweet barilla, sometimes contains 33 per cent. The contaminating substances, are charcoal, and sulphate, or muriate, of soda.*

This alkali is also manufactured in Britain from marine plants, chiefly fuci, which grow on our shores. It is called kelp, and is much inferior to the barilla imported from Alicant and Carthagena, containing only from three to eight per cent. of pure alkali. Its inferiority has been ascribed, and apparently with much justice, to the rude and careless manner in which it is commonly manufactured. (See Jamieson's M. of the S. Isles, vol. II. 44.) Sulphur commonly exists in a considerable proportion in kelp. Mr. Kirwan found this proportion as high as four grains in the ounce, in the best Cunnamara kelp, and that of Strangford seemed equally sulphurous. (Trans. R. I. Acad. III. 23-4.)

Before stating the mode of analyzing barilla and kelp, it may not be improper to mention a prejudice, which commonly influences bleachers in purchasing those commodities, and which is founded on a mistaken view of their chemical properties. When a parcel of those crude alkalies has lain in the storehouses for any considerable length of time, the action of the air causes the larger pieces to break down, and to assume a very different appearance from those recently imported. When the ignorant bleacher sees this, he sets a very inferior value on the goods, and frequently refuses to have them at any price. Now, chemistry teaches us, that the fixed alkalies are imperishable, and cannot be injured by keeping, except they be dissolved by moisture, or washed away by rain. The only circumstance which could depreciate alkalies, in the state just described, is their absorption of carbonic acid and water, whose proportions can be easily ascertained, and the consequent depreciation of value deducted. Nay, these alkalies are rather improved, for the purposes of bleaching, by age; for, by the absorption of carbonic acid, the alkaline sulphuret which they may have contained, is decomposed, and the sulphur separated; whence a much purer ley can be obtained, than from barilla or kelp, recently procured.

I am of opinion, that this mistaken notion, concerning alkalies, may have arisen from a remark made by Dr. Home. (Exper. p. 158.) "These ashes," he says, "ought to be close shut up in casks; for, if exposed to the open air, though in a room, the alternate moisture, and drought, must fix their most useful parts. They become less pungent by keeping, and that on the outside, while their pungency remains

* Some very peculiar doctrines are stated by Mr. Parkes, respecting barilla. He says, that all marine plants, except those cultivated for barilla, yield potash, and not soda, by incineration. He was led into this opinion, by obtaining great quantities of muriate of potash from kelp, to the extent even of many hundred weights per ton. He imagines, that the soda, of kelp, is not derived from the burnt weeds, but from the operation of the potash on the sea salt, producing a decomposition, forming carbonate of soda, and muriate of potash.

Chem. Catech. p. 158.

internally!" And again, (p. 47,) "Muscovy ashes turn weaker every day, till at last they become quite effete." This is obviously from the absorption of carbonic acid; and he does not seem to have known, that this could speedily be extracted by quick lime.

I would earnestly advise the bleacher, in no case to trust to tables for ascertaining the qualities of the alkalies he is about to purchase. Such have been given by Kirwan, and Descroizilles, senior; but they are calculated only to mislead; for every parcel of the crude articles of commerce. differs in its proportions of real alkali, even supposing it to come from the same manufactory. He must ascertain for himself the purity of every parcel, if he wishes to profit by his business. Barilla and kelp may be examined in the same manner which has been already directed for trying potash, or by the method which I shall here lay down, and for which I am indebted to Mr. Parkes.

When any parcel of kelp, or barilla, is to be analyzed, as fair an average sample as possible is to be selected, by breaking small chips from several large pieces, and mixing those with a fair proportion of the small, which may belong to the lot. Let a sample, thus selected, be pulverized in an iron mortar, that the whole may be equally mixed; about an ounce of this is to be ground to an impalpable powder, to facilitate the disengaging of the pure alkali. Take of this powder, 100 grs., and pour upon it two ounces of pure water; stir it occasionally for a few hours, with a glass rod; allow the insoluble matters to subside; pour the supernatant liquid on a paper filter; and add other two ounces of water to the residuum. The whole is then thrown on the filter, in order to secure any lime, or carbonate of lime, which may be present, and would occasion inaccuracy; upon which a little water is also poured, to wash out what remains in the residuum. Both the filtered solutions are then to be put into a vessel, and reduced, by boiling, to two or three ounces. Take two ounces of diluted sulphuric acid, of the specific gravity of 1,100; weigh it accurately, together with the phial, and note down their weight in grains. Pour some of this acid, very gradually, into the solution, and stir it till it ceases to effervesce; when, if it turn red litmus paper blue, more acid, say a drachm, is to be cautiously added, and after stirring, it is to be again tried with the test paper. When the paper begins to be affected but slightly, the acid should only be added by a few drops at a time. The complete saturation of the solution with acid, will be known from the effervescence wholly ceasing; the separation of the sulphur held in solution; and from its not tinging the test paper. The alkali having thus been rendered neutral, the acid in the phial, which has not been used, is to be again accurately weighed, to ascertain how much it has required to saturate the alkali; whence it can easily be calculated, how much real alkali the sample contained, when it is known how much acid a pure alkali will take up. Mr. Parkes ascertained, that 100 grains of pure potash require 520 grains of sulphuric acid, of the specific gravity of 1.100, to saturate it; and 100 grains of pure soda require 812 of the acid. From this, it is evident, that, before commencing the analysis, it will be necessary to learn whether the sample is potash, or soda, or a mixture of both

The crystals of nitro-muriate of platina, dissolved in water, will furnish a test for this purpose; as, when it is dropped into any alkaline solution, it will precipitate potash, but will not affect the soda.

Recovery of Alkali from Waste Leys.

It is a very bad practice among bleachers, and it is almost universal, to use, again and again, the alkaline leys, which must be loaded with impurity: they are often so much so, indeed, as to approach to coagulation. They are led to this, from a notion of economy, being unwilling to throw away any alkali which they can any way employ. But it would often be more economical to purify the ley, before using it; and a method of doing this is also a desideratum for procuring fresh alkali from leys which can no longer be used. Several plans for this purpose have been suggested, but few have been successful, or, at least, economical. Des Charmes advises the residual ashes to be moistened with the ley, and burned in a common kitchen fire, in which wood is the usual fuel. He also recommends boiling the waste leys with quicklime, which is found to be one of the best ways of management, as the lime decomposes the impure vegetable matter floating in the leys, and renders them transparent and caustic, though not altogether so pure as fresh made ley. (See Art of Bleach. p. 558.) This is chiefly practicable, however, when the leys have been used for cottons; for the resinous extract of linens is not so easily acted on by the lime, without adding, along with the lime, as may easily be done, a small quantity of the fresh precipitated earth of alum. The mixture should be constantly agitated during the process, in order to expose every particle of the resinous and extractive matter to the action of the lime. Des Charmes, in this, gives directions quite opposite from those practised by the bleachers around Glasgow. They find that the lime acts better in a cold solution, than with the addition of heat. (See Ramsay's Treatise.) Another mode is by calcining the waste leys in a reverberating furnace, or in the apparatus called the stone boiler, already described; and by these means, alkali can thus be obtained purer than that which is imported; which, in extensive bleach-works, that can afford the expense of the apparatus, is of great consequence. The ley is first evaporated, till it becomes of the consistence of treacle, (see Des Charmes, p. 92,) when it is put into the furnace, or boiler, where, being dried, it takes fire, and burns vividly. The mass is thus melted, and is found to consist of pure alkali; for all the resin and extractive matter are completely consumed; and the carbon, formerly taken up from the cloth, reduces the sulphate of potash to the state of a carbonate, and this carbon is again taken up by the quicklime, used to render it caustic; so that it is nearly in a state of purity. If boilers are used, their safety should be insured by the ingenious method recommended by Mr. Ramsay, of Glasgow. (See Ann. of Philos. I. 258.)

The home manufacture of alkalies, is but slightly connected with the direct subject of the sketch; yet, I cannot help remarking, that it ought to be carefully attended to. We are indebted to Spain, for an

annual supply of several thousand tons of barilla, and to America and Russia, for incalculable quantities of pot and pearl ashes; while we possess considerable resources at home, which are either altogether neglected, or ignorantly and unskilfully managed. The French, with the most laudable spirit of industry and enterprise, take advantage of their wine leys, to prepare an ash (Cendre Gravelées) from the leys of wine, which contains no less than 60 or 70 per cent. of pure alkali, (Des Charmes, p. 279.) We cannot, indeed, for want of material, produce this alkali; but let us turn to account the resources we possess. Let endeavours be made to improve the kelp manufacture, by constructing proper furnaces for its combustion, and by preparing the sea-weeds, whence it is to be made, according to well ascertained chemical principles. Let the furze, broom, and fern, which grow in such great abundance in some of our waste lands, be turned into potash; or let such plants as best afford alkali, be cultivated expressly for its manufacture. The tansey (Tancetum vulg. Lin.) is, according to Lord Dundonald, one of those; and as it grows in abundance in a wild state, on the banks of the Clyde, it is highly probable that its cultivation would be extremely easy. Potash may be procured from saltpetre, by heating it with charcoal, so as to decompose its acid. In this way, we are told by Parkes, that one hundred weight of the nitre will produce half that quantity of pure potash. During our late disputes with America, a great quantity of saltpetre was used for this very purpose; and when the prices will admit of it, considerable profit may in this way be gained. Potash may also be made from peat ashes.

On the Theory and Practice of Cider making.

By a Correspondent.

Exeter, Aug. 9, 1826.

Sir—In making cider, very much indeed depends on the management, as from the same fruit, ciders very different in colour, and in quality, may be produced: for instance, if the apples are ground down and submitted to the action of the press at once, then committed to the vat, and there fermented, the cider will be harsh, and nearly colourless: but, if apples from the same tree, and gathered at the same time, are ground down in the latter part of the day, and not committed to the press till the following day, the action of the air on the pulp will cause the cider to acquire a considerable degree of colour.

For making strong Ciders the process is as follows:—A layer of wheat-straw is placed on the bottom of the press in a square form, and on this a layer of the pulp of about an inch in thickness; a second layer of straw is then placed on this, but in a contrary direction to the former, and so as to lie across it at right angles; and then another layer of the pulp, and so on alternately; layers of straw and pulp are continued, until as much is put in as you propose to submit to the action of the press, at once. The press is now brought down

on it, until a few quarts of juice are expressed, and the sides of the mass (called the cheese,) are pared with a hay-knife, into a regular square. The press is then raised, the parings are laid on the top of the cheese, the juice which had been expressed is poured on its centre, that it may again pass, and thus become fine; the press is again brought down, and about one third of the cider forced out: it is then suffered to remain until the evening, when the press is raised and the cider carried to the vat; the cheese is now pared round, by first cutting off its angles, and making it octangular, and then dressing it round, by paring off thin slices, all which parings are again placed on its top, and the press again brought down, and more of the cider forced out; and this process is continued, until the cheese is very much reduced in diameter, care being taken so to pare it, that its centre continues directly under the centre of the screw of the press. By this process of paring, the kernels of the apples are cut by the knife, and this gives the peculiar flavour to the cider; and by thus continually reducing the diameter of the cheese, the power of the press is continually increased, and this ensures the complete expulsion of all the juice. The juice is then transferred to the vat, which is a vessel of sufficient capacity to contain the product of one cheese, be it one or five hogsheads: after the liquor has been a little time in the vat, it will begin to sparkle, which will rapidly increase, until it arrives to an apparent ebullition, which at length subsides; and the cider thus fermented, is racked off into the vessels intended for its reception, where it soon completes its fermentation; care being taken every day, to keep it filled up, until such fermentation has ceased, when it is bunged down, and a small hole kept open a little time longer, which is finally stopped by a peg. Cider thus prepared will be highly coloured, of good flavour, and very strong.

For preparing sweet, luscious Cider:—As much should be drawn from the cheese at once, as will, after depuration in the vat, nearly fill the vessel intended for its reception. This is to be placed in the vat, which must not be quite filled. As the whole of this process consists in checking the fermentation, care must be taken to draw it off from the lees, the very instant of its commencement, and this cannot be known by sight; as should we by any accident delay drawing it off from the lees, until the sparkling we before noticed, has made its appearance, it would then be too late, the lees having by that time again begun to incorporate with the liquor; and these lees, containing the fermenting principle, the fermentation will proceed rapidly, and go on until it has quite destroyed the whole of the saccharine matter, which it is the intention of this process to preserve. Resort must therefore be had to some other method of discovering symptoms of approaching fermentation; and this is found in the carbonic acid gas, which all fermenting matters throw off, from the very commencement of the process. After the liquor, therefore, has stood in the vat about sixteen hours, a small bit of candle is fixed on the end of a wire, which is turned up for that purpose; this candle being lighted, is let gently down from the edge of the vat, until it comes in contact with the surface of the cider, and if it continues to burn

clear, it is considered that it is not time to draw it off; it being desirable that it should remain in the vat, as long as is consistent with safety, that it may deposit as much of its feculence as possible. It is therefore tried with the candle, as before, every hour, until it is perceived that the candle on approaching the surface of the cider, burns dim, which it will do, as soon as the carbonic acid gas begins to form, and will often be extinguished by it. This gas being heavier than atmospheric air, always floats on the surface of the cider.. Immediately this sign is discovered, which generally happens after the cider has stood in the vat from sixteen to twenty-four hours, the cider is carefully drawn off, so as not to disturb the lees, and transferred into a hogshead, which must not be quite filled; in about a week after this, the above experiment with the candle must be repeated, by introducing it into the bung-hole of the hogshead, and this should be attended to every five or six hours, until the symptom of approaching fermentation is again discovered, when the cider is to be again drawn, or as it is called, racked off, into another hogshead, where it, in general, remains without further racking, until a year has passed over it; although some sorts of cider will require another racking, after about three weeks from the last, but this generally happens where the former operations were a little neglected.

Ciders thus managed, retain all their sweetness, and are, many of them, superior to most of the white wines.

I remain, sir,
Your most obedient servant.
EXONIENSIS.

To T. GILL, *Esq.*

[*Technical Repository.*

Enquiries, and Observations, on the Comparative Power of Steam Engines.

TO THE EDITOR OF THE LONDON MECHANICS' MAGAZINE.

SIR—As a great deal has been said from time to time, respecting the most accurate mode of calculating the horse power of a steam engine, I beg to make the following statements for the information of your intelligent readers.

Boulton and Watt, Mr. Maudsley, and Mr. Fawcet of Liverpool, have each lately finished, and set to work, in three steam vessels of similar tonnage, three pairs of 70 horse power engines. The two 70s, furnished by Boulton and Watt, are of the following dimensions.

	In.
Diameter of each cylinder	$44\frac{1}{2}$
Length of the stroke	54
Those by Maudsley are,	
Diameter of each cylinder	47
Length of the stroke	54

By Mr. Fawcet of Liverpool are,

Diameter of each cylinder	$46\frac{1}{2}$
Length of the stroke	51

Query. Which of these are the most correct in their proportions.

A Subscriber.

Comparative Proportions of Steam Engines.

Sir—Your correspondent who has stated, as above, the diameters of the cylinders, and lengths of stroke of three steam engines of 70 horse power, lately made for steam vessels by Messrs. Boulton and Watt, Mr. Maudsley, and Mr. Fawcet, has omitted to mention the number of strokes which the different engines are intended to make per minute; this is an essential particular for any computation on the power which an engine can exert; for other circumstances being similar, the powers of steam-engines will be proportionate to the quantity of steam expended by them in a given time; so that a smaller cylinder, whose piston moves quicker than that of a larger one, may exert a greater power.

The proportions originally established by Mr. Watt, for the cylinders of his engines of different powers, are such as to allow 33.1 cubic feet of steam per minute, to produce each horse power.

For instance, his 40 horse engine had a cylinder $31\frac{1}{2}$ inches diameter, and the piston made $17\frac{1}{2}$ double strokes per minute, of 7 feet each, so that it passed through 245 feet per minute. The area of a circle, $31\frac{1}{2}$ inches in diameter, is 779 square inches, or 5.41 square feet, which, multiplied by 245, gives 1325 cubic feet of steam expended per minute, by the motion of the piston, without making any allowance for the extra quantity expended by waste of condensation, or leakage. This is at the rate of 33.1 cubic feet per minute for each horse power.

Again, his 20 horse engine had a cylinder $23\frac{3}{4}$ inches diameter, its piston made $21\frac{1}{2}$ strokes per minute, of 5 feet long; or it moved 215 feet per minute; the expenditure of steam was 662 cubic feet per minute, or equal to 33.1 cubic feet per minute for each horse power.

This allowance has been followed ever since by Messrs. Boulton and Watt in their large engines for manufactories, though they have, in many cases, reduced the lengths of the strokes, and enlarged the diameter of the cylinders; for instance, their modern 40 horse engine has a cylinder of $32\frac{1}{2}$ inches diameter, and the piston makes 19 double strokes per minute, of six feet each, or it moves 228 feet per minute, which is an expenditure of 1304 cubic feet of steam per minute, or a little less than Mr. Watt's old engine, though the cylinder of the latter is smallest.

If 33 cubic feet per minute is allowed for each horse power, then the effective pressure upon each square inch of the piston, will be 6.944 pounds per square inch, without any deduction for friction or imperfect exhaustion. The following rule is adapted to this proportion.

*To find the power of a steam engine, on Mr. Watt's principle, in horse power.**

Rule.—Multiply the square of the diameter of the cylinder in inches, by the motion of the piston in feet per minute, and divide the product by 6050; the quotient is the power of the engine in horse power.†

Example.—Cylinder 23¾ inches diameter, squared = 564 circular inches area, × 215 feet motion per minute, = 121,260 cylindrical inch feet of steam expended per minute, ÷ 6050 = 20 horse power.

The calculation may be conveniently performed by the two lines marked C and D upon a sliding rule, when the slider is set in the following manner:—

Sliding Rule. $\left\{\dfrac{\text{C feet per min.} \qquad \text{Horse power of Eng.}}{\text{D} \quad 246\ddagger \qquad \text{Diam. of cylin. inch.}}\right.$

The above may be depended upon as an authentic rule for Mr. Watt's engines on shore. It should be observed, that a properly constructed engine, with a sufficient boiler, is capable of exerting full half as much more as its nominal power; so that a 40 horse engine, with a suitable increase of fuel, is able to do the work of 60 horse power, or a 20 horse engine can exert 30 horse power. In this respect, the old engines, such as were constructed by Mr. Watt himself, are greatly preferable to their descendants of the present day, which in performing their evolutions with a more quiet motion, have lost much of the activity of their noisy progenitors.

In steam-vessels, it would be useless to load the vessel with any more weight than is absolutely necessary, and hence it is the universal practice to urge the engines on board such vessels, to their very utmost power, the throttle valve being always kept fully open, when the vessel is under weigh; and as such engines have an unlimited command of cold water for condensation, they may be considered as always exerting half as much more power as they are rated at, or that two 40 horse engines, always exert 120 horse power; two fifties, 150 horse power; two sixties, 180 horse power; and two seventies, 210 horse power. The best steam-boat engines, exceed even this proportion, considerably.

If your correspondent can state with certainty, the number of strokes each of the seventy horse engines is intended to make, the diameters of their paddle-wheels, the length and breadth of those paddles, their number, how much they dip into the water, and the dimensions and draft of water of the vessels, their names, the ser-

* A horse power is that exertion of moving force which, besides overcoming all friction, will raise 33,000 pounds weight one foot high per minute; or any smaller weight a proportionably greater height in the same time.

† The divisor, 6050, is the number of cylindrical inch feet (i. e. small cylinders one inch diameter, and one foot long) that are contained in 33 cubic feet; for a square foot contains 183.346 circular inches × 33 = 6050.42.

‡ The number 246, which is used as a guage point on the line D of the sliding rule, is the square root of nearly ten times 6050 or 60,516; or the number 77.78 which is the square root of 6050, may be used for the guage points, and will give the same result as 246.

vices they are employed in, the speed with which they move through still water, and any other particulars, it would be very useful and interesting to many of your readers.

I am, &c. X.

P. S. I have been told that Mr. Maudsley's cylinders are 46½ inches, but your correspondent says 47.

On the relative proportions of the various parts of the Boulton and Watt's, or low pressure, Steam Engine; the fuel required for working engines of different powers, and the effect produced, in Pumping Water, or Grinding Wheat.

We have been furnished with a copy of a table containing the very important results of the experience of Boulton and Watt, in proportioning the most essential parts of their steam engines, together with some other particulars, a knowledge of which ought to be possessed, not only by the manufacturer of those machines, but also by every engineer. This table has never before appeared in print, but manuscript copies of it are possessed by the principal engineers of Great Britain, from one of whom it was procured, by an American engineer, who has recently visited that country.

The preceding article on the comparative proportions of steam engines, which we have extracted from a late number of the London Mechanics' Magazine, is, manifestly, written by a person well acquainted with the subject upon which he treats, and will, in several respects, be a useful introduction to this table, which we have subjoined.

In these tables, the calculations, it will be seen, are made for steam of two pounds to the square inch, and when the pressure is greater, the calculations must, of course, be so modified as to suit this variation. For the sake of the general reader, it may be well to observe, that by two pounds to the square inch, is intended two pounds above the ordinary pressure of the atmosphere, making, of course, about 17lbs. on every square inch of the surface of the piston. If the pressure exceed four pounds upon the square inch, it is no longer a true low pressure engine; and, in this country there are very few of this kind. Those denominated low pressure, and used on board our steam boats, work, ordinarily, under a pressure of from 7 to 14lb. upon the inch, and, as the boilers are made strong in proportion, and varied in their form, so as to sustain this pressure, they are, under proper management, equally safe with those of lower pressure.

The table supposes the working pressure upon every square inch of the piston, to be equal to ten pounds; but in the low pressure engine, it would be accounted a good average to equal one half of the elastic power of the steam, which at 17lb. to the inch, would amount to 8½lb.; one half the power being expended in overcoming friction and inertion, and in unavoidable imperfections in workmanship.

Editor.

Boulton & Watt's calculation of Steam Engines.

(Steam two pounds to the square inch.)

No. of Horses Power.	CYLINDER.				
	Inches Diameter.	Inches area.	Inches Contents.	STROKES. Length.	STROKES. No. per minute.
1	6	28.274	508.932	1.6	60.
2	9	63.617	1526.808	2.	50.
4	12	113.1	3393.	2.6	40.
6	14	153.94	5541.84	3.	33.3
8	16	201.062	8444.52	3.6	28.571
10	17.5	240.53	11545.44	4.	25.
12	18.75	275.117	13205.616	4.	25.
14	20.2	320.474	17305.596	4.6	22.2
16	21.5	363.65	19604.7	4.6	22.2
18	22.8	408.28	24498.	5.	20.
20	24.	452.4	27144.	5.	20.
22	25.2	498.76	29925.6	5.	20.
24	26.3	543.41	35865.06	5.6	18.18
26	27.3	585.35	38633.1	5.6	18.18
28	28.4	633.5	45612.	6.	16.6
30	29.5	683.5	49212.	6.	16.6
32	30.3	721.08	51917.76	6.	16.6
34	31.2	764.54	59634.12	6.6	15.38
36	32.2	814.34	63518.52	6.6	15.38
38	33.1	860.5	72282.	7.	14.28
40	34.	908.	76272.	7.	14.28
42	34.75	948.42	79667.28	7.	14.28
44	35.6	995.4	91576.8	7.6	13.3
46	36.4	1040.62	95737.04	7.6	13.3
48	37.2	1086.87	104339.52	8.	12.5
50	38.	1134.12	108875.52	8.	12.5
52	38.7	1176.29	112923.84	8.	12.5
54	39.5	1225.42	124992.84	8.6	11.7647
56	40.2	1269.24	129562.48	8.6	11.7647
58	40.8	1307.	141156.	9.	11.
60	41.6	1359.18	146791.44	9.	11.
62	42.25	1402.	151416.	9.	11.
64	43.	1432.2	154677.6	9.	11.
66	43.6	1493.014	161145.08	9.	11.
68	44.25	1537.86	166088.88	9.	11.
70	45.	1590.44	171767.52	9.	11.
72	45.6	1633.13	176378.04	9.	11.
74	46.25	1682.02	181658.16	9.	11.
76	46.8	1720.21	185782.68	9.	11.
78	47.5	1772.06	191382.48	9.	11.
80	48.	1809.56	195432.48	9.	11.
82	48.6	1855.08	200348.64	9.	11.
84	49.2	1901.17	205326.36	9.	11.
86	49.8	1947.82	210364.56	9.	11.
88	50.4	1995.04	215464.32	9.	11.
90	51.	2042.725	220614.3	9.	11.
92	51.5	2083.077	224972.316	9.	11.
94	52.	2123.72	229361.76	9.	11.
96	52.6	2173.	234404.	9.	11.
98	53.2	2222.87	240069.96	9.	11.
100	53.75	2269.07	272288.40	10.	10.

Boulton & Watt's calculation of Steam Engines.

(Steam two pounds to the square inch.)

No. of Horses Power.	AIR PUMP.				CONDENSER
	Inches Diameter.	Inches area.	Stroke.	Contents.	Contents ⅓ of Cylinder.
1	4.	12.5664	.9	113.1	170.
2	6.	28.2744	1.	339.3	509.
4	8.	59.2656	1.3	714.	1131.
6	9.3	76.93	1.6	1334.74	1847.28
8	10.6	88.25	1.9	1853.25	2814.5
10	11.6	105.683	2.	2536.402	3848.5
12	12.3	118.823	2.	2851,756	4401.872
14	13.3	139.93	2.3	3751.11	5768.532
16	14.3	160.606	2.3	6336.374	6535.
18	15.2	181.459	2.6	5443.77	8166.
20	16.	201.062	2.6	6031.872	9048.
22	16.8	221.671	2.6	6650.138	9975.2
24	17.53	241.354	2.9	7964.686	11955.
26	18.3	263.02	2.9	8679.74	12877.7
28	18.93	281.444	3.	10131.987	15204.
30	19.66	303.57	3.	10928.52	16404.
32	20.2	320.474	3.	11537.086	17306.
34	20.8	339.8	3.3	13252.2	19878.
36	21.5	363.05	3.3	11459.	21172.84
38	22.	380.1336	3.6	15965.6112	24094.
40	22.6	401.151	3.6	16848.342	25424.
42	23.13	420.186	3.6	17647.835	26555.76
44	23.73	442.269	3.9	19902.105	30525.6
46	24.3	463.77	3.9	20869.68	31912.35
48	24.8	483.052	4.	23186.516	34780.
50	25.3	502.7267	4.	24130.8809	36291.84
52	25.8	522.8	4.	25094.4	37641.28
54	26.3	543.41	4.3	27713.93	41664.28
56	26.8	563.1	4.3	28718.39	43187.5
58	27.2	581.07	4.6	31377.8	47052.
60	27.73	604.	4.6	32616.	48930.5
62	28.16	622.81	4.6	33611.79	50472.
64	28.66	645.1241	4.6	34836.7016	51559.2
66	29.06	663.2574	4.6	35815.9	53715.
68	29.5	683.5	4.6	36909.	55363.
70	30.	706.86	4.6	38160.44	57255.84
72	30.4	725.835	4.6	39195.104	58792.68
74	30.83	746.514	4.6	40311.756	60552.72
76	31.2	764.54	4.6	41285.16	61927.56
78	31.6	784.27	4.6	42350.58	63794.16
80	32.	804.25	4.6	43429.5	65146.16
82	32.5	829.578	4.6	44797.252	66783.
84	32.8	844.9647	4.6	45628.0957	68442.
86	33.2	865.7	4.6	46747.8	70121.52
88	33.6	886.685	4.6	47881.	71821.44
90	34.	907.922	4.6	49027.809	73538.3
92	34.33	925.6323	4.6	49984.1445	74998.8
94	34.66	943.513	4.6	50949.716	76454.
96	35.	959.75	4.6	51827.	78134.66
98	35.46	987.571	4.6	53328.837	80023.32
100	35.83	1008.288	5.	60497.280	81616.52

Boulton & Watt's calculation of Steam Engines.

(Steam two pounds to the square inch.)

No. of Horses Power.	INJECTION WATER.		BOILER	COALS for 12 hours.		Pumping	GRINDING.
	Gallons per stroke.	Gallons per min.	Contents in gallons.	BUSHELS Empty.	Loaded.		Winchester bush. wheat per hour.
1	.176	7.	24.5	.5	1.5	Ten pounds working pressure on the square inch of the piston, will raise water 20 feet by a pump of the same diameter, and stroke, with the piston.	1.885
2	.26	13.	49.	1.	3.		4.241
4	.5	20.	98.	2.	6.		7.54
6	.848	28.	147.	3.	9.		10.2
8	1.26	36.	196.	4.	12.		13.4
10	1.72	43.	245.	5.	15.		16.0353
12	2.	50.	294.	6.	18.		18.34
14	2.5675	57.	343.	7.	21.		21.
16	2.882	64.	392.	8.	24.		24.2154
18	3.6	72.	441.	9.	27.		27.88
20	4.	80.	490.	10.	30.		30.16
22	4.4	88.	539.	11.	33.		33.25
24	5.2805	96.	588.	12.	36.		36.2272
26	5.725	104.	637.	13.	39.		39.0232
28	6.9306	112.	686.	14.	42.		42.226
30	7.4257	120.	738.	15.	45.		45.567
32	7.9207	128.	784.	16.	48.		48.072
34	8.84	136.	833.	17.	51.		51.
36	9.36	144.	882.	18.	54.		54.2887
38	10.71	152.	931.	19.	57.		57.367
40	11.2	160.	980.	20.	60.		60.53
42	11.76	168.	1029.	21.	63.		63.2347
44	13.233	176.	1078.	22.	66.		66.36
46	13.834	184.	1127.	23.	69.		69.3747
48	15.36	192.	1176.	24.	72.		72.458
50	16.	200.	1225.	25.	75.		75.608
52	16.64	208.	1274.	26.	78.		78.4193
54	17.85	216.	1323.	27.	81.		81.6947
56	19.04	224.	1372.	28.	84.		84.616
58	20.9	232.	1421.	29.	87.		87.13
60	21.621	240.	1470.	30.	90.		90.612
62	22.342	248.	1519.	31.	93.		93.53
64	23.063	256.	1568.	32.	96.		96.
66	23.783	264.	1617.	33.	99.		99.53
68	24.504	272.	1666.	34.	102.		102.524
70	25.22	280.	1715.	35.	105.		106.03
72	25.945	288.	1764.	36.	108.		109.
74	26.6	296.	1813.	37.	111.		112.1347
76	27.3838	304.	1862.	38.	114.		115.
78	28.1171	312.	1911.	39.	117.		118.1373
80	28.82	320.	1960.	40.	120.		121.
82	29.549	328.	2009.	41.	123.		123.672
84	30.27	336.	2058.	42.	126.		126.7447
86	30.9	344.	2107.	43.	129.		129.8547
88	31.70	352.	2156.	44.	132.		133.
90	32.43	360.	2205.	45.	135.		136.18167
92	33.153	368.	2254.	46.	138.		138.8718
94	33.173	376.	2303.	47.	141.		141.5813
96	34.594	384.	2352.	48.	144.		144.87
98	35.315	392.	2401.	49.	147.		148.2
100	40.	400.	2450.	50.	150.		151.2713

Economical method of keeping Horses.

By Henry Sully, *M. D.*

Sir—If the following description is considered as of use to any of your numerous readers, I beg it may be inserted in your Mechanics' Magazine, as the best mode I can devise of diffusing, most extensively, a plan I am daily requested to describe, and which, for above 17 years, I have invariably followed with a success that most of my neighbours have witnessed, and, as a thorough good chaff-cutter, and corn-bruiser, are matters of high importance, we may be favoured with improvements which some of your correspondents have instituted.

I am, Sir,
Your obedient Servant,
Henry Sully, M. D.

When the scarcity of horse provender renders it so expensive, as it is likely to prove the ensuing winter, one cannot do a greater service to his countrymen, than by pointing out to them, a plan by which their expenses may not only be lessened, but their cattle kept in better condition.

Having received innumerable letters from gentlemen who keep horses, requesting a description of my plan of feeding, I shall save much future trouble, both to others as well as myself, by laying my system before the public. Having pursued the plan above 17 years, I am enabled to appreciate its full value, and, being perfectly satisfied of its superior excellence, I hope to continue the same as long as I keep horses. Most people who know me will allow, that horses in my employ enjoy no sinecure places, and few people can boast of their cattle being in better working condition, or more capable of laborious undertakings, than mine.

The loft above my stable contains the machinery for cutting chaff, and grinding corn. From this loft each horse has a tunnel of communication with the manger below, and a tub annexed to each tunnel in the loft for mixing the ingredients composing the provender. There should be no rack in the stable, because this may tempt the groom to fill it with hay, and thus, by overloading the horse's stomach, endanger his wind, to say little of its expense and waste, for it is a well known fact, that if a horse has his rack constantly replenished with hay, he consumes, and spoils, upwards of 30lb. per day; whereas in chaff, his utmost allowance is 10lb. in 24 hours. The manger with which the tunnel communicates, should have cross bars, of firm oak, placed at the distance of 10 or 12 inches from each other, to prevent the horse from wasting his provender in search of the grain it contains, and this space between the cross bars, allows the horse plenty of room to take his food.

The chaff-cutter I make use of, is manufactured by Mr. Wilmott, a very ingenious mechanic, who resides about five miles from Taunton, on the road to Wiveliscombe. He also provides corn-bruisers

upon the best construction, and any person keeping three or four horses, will save the prime cost of his machinery the first year of its trial, and the horses themselves, thus fed, to use the language of horse keepers, will always be above their work.

When the provender is thoroughly mixed in the tub, previously weighing out each ingredient, the mixture should be given in small quantities at a time, many times in a day; and, at night, enough is thrown into the tunnel, to last till the morning. This process will be found of very little trouble to the groom, who will only have to go into the loft six or eight times a day. As the component parts of the provender are weighed out separately for each horse, we are certain he has his just proportion; and I have hereunto annexed my scale of feeding, in four classes, for it sometimes so happens, that some of the ingredients cannot be procured, and, at other times, that it may be better to substitute others; but, whatever grain is given, it should always be bruised, or coarsely ground, and carefully weighed out; for by weight, alone, is it possible to judge of the quantity of farinaceous substances the horse consumes; it being well known, that a peck of oats varies from seven to twelve pounds; consequently, if the provender were mixed by measure, there would be frequently an uncertainty, as to quantity. Wheat varies from 16 to 12. Barley, from 13 to 10. Pease, from 17 to 15. Beans, from 17 to 15 per peck. And, as wheat, beans, pease, barley, and oats, are equally good, and of very trifling difference in price, when their specific gravity is taken into consideration, I am equally indifferent which grain I use, but I should always prefer boiled, or steamed, potatoes, for hard working horses, to be a component ingredient, whenever they can be procured.

As I call all ground or bruised grain, of whatever description, *farina*, it will be so distinguished in the following

Scale.

	Class 1.	Class 2.	Class 3.	Class 4.
Farina, consisting of bruised or ground beans, pease, wheat, barley, or oats,.........	5 lb.	5 lb.	10 lb.	5 lb.
Bran, fine or coarse pollard,...............	—	—	—	7 lb.
Boiled or steamed potatoes, mashed in a tub, with a wooden bruiser,................	5 lb.	5 lb.	—	—
Fresh grains,..............................	6 lb.	—	—	—
Hay, cut into chaff,........................	7 lb.	8 lb.	10 lb.	8 lb.
Straw, or reed, in chaff,...................	7 lb.	10 lb.	10 lb.	8 lb.
Malt dust, or ground oil cake,............	—	2 lb.	—	2 lb.
Salt,......................................	2 oz.	2 oz.	2 oz.	2 oz.

By the above scale, it will be seen, that each horse has his 30 lb. of provender, in 24 hours, which, I maintain, is full as much as any horse ought to eat, and is more than some can eat. The two ounces of salt will be found an excellent stimulus to the horse's stomach, and should, on no account, be omitted. When a horse returns from labour, perhaps the groom will see the propriety of feeding him from his tub more largely, in order that he may be the sooner satisfied, and lie down to take his rest.

Whenever oat straw can be procured, it is generally preferred; and some like to have it cut into chaff, without threshing out the oats; but this is a bad plan, for, in preparing a quantity of this chaff, unequal proportions of oats will be found in each lot, so that one horse will have too large a portion, whilst others have less than they ought, although the portions are accurately weighed.

The only certain method, then, is to let the grain, of whatsoever description, be weighed separately from its straw, and the keeper of horses will soon satisfy himself, that his cattle are in want of nothing in the feeding line. Many people object to potatoes, and think them unfit for working horses; but, from many years' experience, I am enabled to recommend them as a constituent part of the 30 lbs., and am convinced, that it is as wholesome and nutritious a food, as can be procured for labouring horses, which are called, upon sudden emergencies, to perform great tasks, as has been abundantly proved by Mr. Curwen, M. P., who kept above one hundred horses on potatoes and straw, and always found that their labours were conducted better on this, than any other food.—See Curwen's Agricultural Hints, published in 1809. HENRY SULLY.

Wiveliscombe, Somerset, Sept. 12, 1826.

[*Lon. Mech. Mag.*

On Automata and Androides.

BY THE EDITOR.

IT is not our intention to attempt even a bare enumeration of all the Automata and Androides, which have been exhibited to the public, and are described in different works, as articles of great curiosity; this would lead us far beyond the limits, within which we must necessarily confine this article: nor is it intended, now, to describe the mechanism by which any of these instruments were moved; but merely to gratify curiosity, by some account of the performances of a few of those which have been among the most celebrated.

M. Camus has given an account of an ingenious piece of mechanism, which he constructed for Louis the XIV. when a child. It represented a lady proceeding to court, in a small chariot drawn by two horses, and attended by her coachman, footman, and page. When the machine was placed at the end of a table of a determinate size, the coachman smacked his whip, and the horses started off, exhibiting all the natural motions of that animal, and the whole equipage drove on to the further extremity of the table; it now turned at right angles in a regular way, and proceeded to that part of the table opposite to which the prince sat, when the carriage stopped, the page alighted to open the door, and the lady came out with a petition, which she presented, with a curtsey. After waiting some time, she again curtsied, and re-entered the carriage; the page then resumed his place, the coachman whipped his horses, and the footman, after running some time after the carriage, jumped up behind it.

Such is the account given by the maker of this ingenious toy; he has not, however, described the mechanism, by which the different motions were produced; and we doubt very much, whether a view of the thing in action, were it now before us, would justify the expectations, which the account appears to be intended, and is certainly calculated, to excite. The different figures must necessarily have retained their connexion with the carriage, and what is said about the running of the footman, and the movements of the other figures, is, undoubtedly, an exaggeration, as is usually the case, on subjects of this description.

M. Vaucanson, a member of the Royal Academy of Sciences, in France, constructed various pieces of mechanism, of a very superior class. In the year 1738, he exhibited in Paris, a machine capable of performing various airs upon the German flute. A very exact account of the structure of this instrument, was communicated by him to the Academy, which account was published in their Transactions; an abstract of this may be found in Rees' Cyclopedia, or the Edinburgh Encyclopedia, under the articles Androides, and Automaton.

This figure was about five and a half feet in height; it stood upon a pedestal of four and a half feet in height, within which were contained the bellows, which supplied the wind, and the clock-work, by which they were driven; the whole so carefully constructed, that not the slightest noise was made by any of the moving parts. The fingers, the lips, and the tongue of the figure, had each their proper motions; which were regulated with the utmost precision, by means of levers and chains, acted upon by the rotation of a steel barrel, furnished with pins for that purpose.

The same gentleman, in 1741, produced, and exhibited to the Academy, another figure, which played upon the pipe and tabor; it was, like the flute-player, fixed upon a pedestal, and was habited as a dancing shepherd: it was capable of playing about twenty tunes, consisting of dances of various kinds. This mechanism was not less admired than the flute-player; for, although it might, at first, appear, that, from the simplicity of the instruments played upon, the motions would be more readily given, yet the fact is far otherwise. The shepherd's pipe is one of the most imperfect, and untoward, of all musical instruments; it has only three holes, and the variety of its tones depends chiefly upon varying the force of the wind, and upon covering the orifices more or less perfectly. These variations in the force of the wind, must be given with a rapidity which the ear finds it difficult to follow, and the articulation of the tongue must be communicated to the quickest notes, otherwise the instrument is disagreeable. In all these points, the Automaton surpassed the most expert players on the pipe and tabor. The machine played complete airs, with rapid passages, which the best performers are compelled to slur over, and gave the requisite articulations of the tongue, at every note.

The same ingenious person made an artificial duck, which imitated, with astonishing precision, all the actions of the living animal. In its external form, the resemblance to its prototype, was perfect: its wings were anatomically exact in every part; not a bone in the body

of the original, and scarcely a feather, seemed to have been overlooked in this most accurate imitation. The automaton ate, drank, and quacked, in perfect harmony with nature. It gobbled food with seeming avidity, drank, and muddled the water, after the manner of the living bird. It not only swallowed, but appeared to digest, the food, and evacuated it, apparently changed in its nature.

Numerous writing figures have been exhibited, and the construction of them is well understood; the motion of the hand being directed by a concealed accomplice, who moves one limb of a pantograph, the other end of which terminates in the hand of the figure. The machine used for tracing profiles, are, ordinarily, of this kind. We have seen several such writing figures, but all much inferior to some which have been described. M. Droz, of Neufchatel, exhibited, in England, and elsewhere, a figure of a man, about the natural size. It held in its hand, a metal style, a card of vellum being laid under it; a spring was touched, which allowed the machinery to operate, it having been previously wound up; the figure then began to draw, and was capable of executing, with great elegance and precision, five or six different subjects, the cards being changed at proper intervals. M. Droz, after winding up the machine, left it for several hours in the care of Mr. Thomas Collinson, a scientific gentleman, after having explained to him the principal parts of the internal structure, and directed him how to use it. The first drawing contained likenesses of the king and queen, facing each other; and Mr. Collinson observes, that it was curious to see the precision with which the figure lifted up his pencil, in making its transitions from one point of the draft to another, without making the least slur whatever; passing from the forehead to the eye, the nose, the chin, or from the waving curls of the hair, to the ear. Mr. Collinson obtained five different drawings, in a way which proved clearly, that the whole was directed by the machinery.

An ingenious mechanician of Switzerland, M. Maillardet, likewise constructed a writing and drawing figure, which was operated upon by the machinery contained within itself. This consisted of the figure of a boy, kneeling upon one knee, and holding a pencil in his hand, with which he executed, not only writings, but also drawings, equal to those of the first masters. When the figure began to work, an attendant dipped the pencil in the ink, and fixed the paper; when, on touching a spring, the figure wrote a line, carefully dotting and stroking the letters. In this way, it executed four pieces of writing, in French and English, each consisting of several lines; it also made three different drawings of landscapes. The motions of the figure were fine imitations of those of animated existence.

A clock was made by M. Droz, which was presented to the king of Spain; besides a number of other moving figures, it contained that of a sheep, which imitated the bleating of that animal; and a dog, watching a basket of fruit: if any one attempted to purloin the fruit, the dog gnashed his teeth, and barked; and if it was actually taken away, he never ceased barking, until it was returned.

M. Maillardet, and M. Droz the younger, made, each of them,

gold snuff boxes, which, though of moderate dimensions, contained, concealed in one of their divisions, a small bird, only three-fourths of an inch in length, of green enamelled gold; this bird, on touching a spring, rose through a small opening in the box, wagged its tail, fluttered its wings, and, opening its bill, sent forth a song of surprising strength and harmony, continuing the whole time in rapid motion, and all its movements corresponding with the music. A box of this description is now in the possession of Mr. Gibbs, broker, of this city, which shows that the foregoing account is by no means exaggerated.

(TO BE CONTINUED.)

THE ARTISAN.—No. 3.

An explanation of the terms used in Chemical Science, with familiar exemplifications. By the Editor.

Among those books which have been professedly written in order to give instruction, in the first principles of science, to those who have not enjoyed the advantages of a regular education, there are but very few which possess the merit of having attained their object. It is in fact no easy task, for one who is himself perfectly familiar with the terms of science, and with the ideas which they are intended to convey, to sustain in his mind an adequate conception, and a constant recollection, of the ignorance on these points, of those whom he is attempting to instruct; yet this ignorance, every teacher should suppose, at least, to be complete, and he should never, for a moment, forget it.

We believe that nothing, but the habit of teaching, can give a full view of the truth of the above remark, and of the extent of those difficulties to which it alludes; this habit has convinced us, that notwithstanding the number of works which have been intended to teach the outlines of chemistry, there is not, in our language, one, which is sufficiently clear and familiar. Several of them are written by persons possessing, unquestionably, a competent knowledge of the subject, but who are not at all aware of all that is necessary to the learner; by far the greater number, however, are incorrect in point of fact.

We have made the preceding remarks in consequence of having felt, while selecting and preparing the materials for this Journal, a difficulty, similar to that of which we have been speaking. We have wished, most ardently, to be useful to practical men, and have published such articles as appeared most likely to promote this object; still, we have been fully aware that in these articles, a language is very frequently used, which, to many of our readers, must be obscure, if not unintelligible; we hope, however, in some measure to obviate this difficulty, by pursuing the plan proposed in the last number of '*The Artisan.*' Having there attempted a familiar illustration of the objects embraced by mechanical philosophy, and by chemistry,

we shall now proceed to an explanation of the most important terms in the latter science, with such exemplifications as may be likely to aid us in the accomplishment of our purpose.

Simples.—Compounds.—By the term *simple*, in chemistry, we mean, any substance, or body, which consists of only one ingredient; whilst by a *compound*, we intend, an article which is composed of two, or more, simples. The term *elementary substance*, is sometimes used in the same acceptation as simple: but we must be careful not to confound the term element, when thus used, with the *elements* of the ancient philosophers. At one period, fire, air, earth, and water, were accounted the elementary, or essential ingredients, of which all other bodies were composed: neither of these, however, has retained its ancient character; they are all now classed among the compounds, having long been, unequivocally, proved to be such.

Although the variety of compound substances is almost infinite, the number of simples, is comparatively small; not amounting, in the whole, to sixty, of which the metals make up about forty.

Decomposition.—Analysis.—Decomposition, is that change which takes place in any compound body, by which its nature is altered; in this case, it either loses the whole, or a portion, of one, or more of its component parts; or it acquires some new material, and is no longer the same body. To analyze a body, is to separate it into the simple, or elementary substances of which it is composed, with a view to ascertain its composition. We cannot analyze, or decompose a simple substance, because it contains only one ingredient. Whenever a body resists every effort to decompose it, and we have not good reason, from analogy, to conclude that it is a compound, it is classed with simple substances. Chemists, however, do not conclude that all the substances which they have so classed, are absolutely simple bodies, but only that they have not yet been decompounded, and that there is no strong analogy to justify the conclusion that they are compounds.

Synthesis is the reverse of analysis, as it signifies the taking the elements of which a substance is composed, and combining them together, so as to produce that substance. Water may serve as an example: this fluid, which is composed of *oxygen* and *hydrogen*, can readily be decomposed, and can as readily be reproduced, by causing oxygen and hydrogen to combine together. We thus obtain both an *analytical*, and a *synthetical* proof, that water is a compound.

Base.—This term is, in general, employed to denote the ingredient which gives to any compound, its particular, or most distinguishing character. Lime, is the base of those cements, which we denominate mortars. Clay, (*argil* or *alumine*,) is the base of the various kinds of earthenware. Iron, is the base of copperas (sulphate of iron,) which consists of iron united to sulphuric acid, (oil of vitriol.) Sulphur, is the base of sulphuric acid, which consists of sulphur united to oxygen.

Caloric.—The matter which produces heat. This term is used, to prevent that confusion which would result from employing the same term, to express two different things, and which does occur in the ordi-

nary use of the word heat; which we employ to indicate a certain sensation, and also, to denominate the article by which that sensation is produced. The propriety of introducing the term *caloric*, will be apparent, when it is known that this same agent, although it sometimes warms a body into which it enters, does not always produce this effect. Ice may serve to exemplify this.

Water, may exist in the form of ice, at a temperature of 32° of Fahrenheit's thermometer; if you take a lump of ice, of this temperature, into a warm room, it will begin to melt; and it is evident that this is in consequence of a portion of the matter of heat, passing into it; the water produced by the melted ice, must, therefore, contain more of the matter of heat, than the ice itself did; yet, if tested, the water will not indicate an increased temperature, nor will it begin to do so, until the whole of the ice is melted, although several hours may be required to effect this. It can be proved, by a direct experiment, that were a quantity of the matter of heat, equal to that which it absorbed while melting, to pass into it, after it is melted, its temperature would be elevated 140°. All this caloric is employed in converting it into, and retaining it in, the fluid state. We might, therefore, with evident propriety, say that the water contained more *caloric*, but not that it had more *heat* than the ice, the temperature remaining unchanged.

Latent Heat.—When caloric enters into a body, without elevating its temperature, it is then said to be *latent;* that is, it is concealed, or hidden. Thus the quantity which entered into the ice, in the example given, produced no alteration of temperature, but only changed the body from the solid to the fluid state; and, so far as temperature is concerned, was concealed or hidden in the water. The term latent heat, was in use before the word caloric had been adopted by chemists, and has, from habit, been continued, although it would evidently be more correct to say *latent caloric*, as the former expression is at variance with the reasoning which justified the adoption of the word caloric.

Free Caloric, or *sensible heat.* That caloric by the acquisition of which a body is heated, and by the loss of which it is cooled, we denominate free caloric, or sensible heat. It must be observed that we restrict the term sensible, in this case, to the sense of feeling, or to a change of temperature. In the example of the melting ice, we can *see* that a solid is changed into a fluid, but we cannot feel, or in any other way discover, a change of temperature.

Before water freezes, it sinks to the temperature of 32°; ice then begins to form, but until the whole of the water, contained in any vessel, be frozen, its temperature remains the same, however intensely cold the weather may be. The reason of this is, that every portion of it which becomes ice, has first to part with its *latent heat*, or that by which it was kept in the fluid form; this being now disengaged, becomes sensible, and therefore keeps up the temperature to 32°. If the quantity which is parted with by every portion of water which becomes frozen, could be suddenly communicated to an equal portion, in the fluid form, it would elevate its temperature 140°. It fol-

lows, therefore, that, could all the heat which is disengaged from a pint of water, in the act of freezing, be made suddenly to pass into a pint of water at 72°, it would cause it to be heated to 212°, or to the boiling point. This large quantity of heat which is disengaged, when water becomes ice, is the reason why the operation of freezing is a very slow one; the water is kept at 32°, by the heat, separated from that portion of itself, which is freezing; and this heat has to be carried off by the colder atmosphere, by which it is surrounded, before another portion can begin to freeze.

In the next number of the *Artisan*, we shall pursue this subject, and shall continue it until we have introduced all those substances and processes, the explanation of which may appear to us most likely to aid the artisan, in the acquisition of first principles. This department will not be restricted to chemical science, although to this will be allotted, a distinct and separate place.

Mechanics, and others, who desire information respecting *terms*, or *processes*, in the different departments of art or science, are invited to send their enquiries, which shall either be answered by us, or be inserted, in order to obtain answers from others.

On Chronometers and Expansion Curbs. By Benj. F. Baker.

TO THE EDITOR OF THE FRANKLIN JOURNAL.

Sir—In the third number of the first volume of the Franklin Journal, I gave a short paper upon the balance of chronometers, as operated upon by the atmosphere. Further observations, since that time, upon these instruments, have not in the least weakened the opinion, then expressed, upon the adjusting screws and loadings; but it is instantly asked, by the practical mechanician, In what way is the time to be preserved uniform, through greatly differing temperatures? The resort must necessarily be to the curb. Suppose, for example, the common lever curb, and flat hair spring; the pins of this curb are to be set so close together, as just to admit, freely, the spring between them; and are to be so shaped, that each pin will present to the spring, a very small surface, (say the edge of a triangle,) that, however long the vibration may be, only the same space upon the spring, will be touched by these pins. Let the chronometer be regulated, precisely as the lever now is, to a tolerable degree of accuracy, before the expanding and contracting attachment, is secured to it. This attachment must be made to act upon the curb itself, so that, when it expands by heat, it will move it (however little) along the index, towards the word *fast;* and the contrary way, towards the word *slow*, when it contracts by cold. This expansive appendage to the curb, may be made, or bent, into various shapes, in order to obtain an operative length of the compounded metals, and be simply screwed to the plate at one end, and to the curb at the other. The first inquiry naturally starting from the ideas of a practical man, will be, how to

bring about a proper quantity of action upon the curb, so as to only, and not more than, counteract the effects of heat and cold upon the timekeeper. This may be accomplished in various ways. Let the screw, that secures it to the plate, instead of passing through a round hole, pass through an oblong one; then, by drawing this screw a little, the end attached to the curb may be moved inwards, or outwards, thus, as it were, shortening, or lengthening, the lever acted upon. This will also be found convenient, when it is thought necessary to reduce the rate of the chronometer; for, by easing this screw, as in the first instance, the expansive attachment may be moved with the curb towards advance, or retard, sliding under the screw-head, it will preserve its relative bearing when again secured.

There are many other ways, by which the expansive curb may be made to act *parallel to the hair spring coil.* The above is given in explanation of the general idea; for it is the *principle* that I would illustrate and recommend, rather than any particular way of applying it. The objection to the expansive curb, now used in lever watches, is, that the action *crosses* the coil of the spring, and tends, as it were, to open, and close, the curb pins. The result will be, that when the curb is adjusted to different temperatures, (which can only be done by much care and observation, during cold weather,) while the oil is fresh in the pivot holes, and the vibration of the balance, long, the same relative effect on the time will not be produced, when the vibration shortens by the evaporation, or thickening of the oil. The expansive curb is generally to be found in all the highest priced lever watches, that come to this country; and yet, the writer never, in a single instance, found one that had been adjusted, even in the slightest manner, to different temperatures. Placed in the watch, merely to add a sounding epithet to its description, and a guinea to its price, they are not only utterly useless, but, in many instances, destroy the regularity of its performance. I have such a one in my shop at the present time, made at an establishment, equal, perhaps, in reputation, to any other. The expansive curb of this watch is so straight, that, at every vibration which opens the coil, the spring touches it nearly the sixteenth of an inch along the end that takes the place of the outer pin. This is so great an error, that it is impossible for the watch to perform with any proper degree of regularity; for every accidental shake it may receive, that widens the motion, the balance receives an additional impulse; and a diminished one, if the shake should shorten the action. I have been thus particular in noticing the ordinary expansive curb, from a belief, that foreign machinists must smile at our simplicity, in ordering, and paying for, a thing which is not merely useless, but injurious to the time of the watch that contains it.

The chronometer scapement, divested of its loaded balance, made, and placed with accuracy, and also with a view to prevent its setting, when used for the pocket, is, beyond all question, the best mechanical arrangement for a moveable time-keeper, that has been discovered. Completely detached in its action, the balance receives

its impulse directly from the crown wheel, at a distance from its pivots, nearly, or quite equal to, the whole space between the teeth of that wheel. In no other scapement, can this be accomplished. It is acted upon with less friction than any other, because the impulse given, follows more nearly the direction through which the balance moves, and, consequently, not being an angular rub, the points of the crown wheel teeth, will do perfectly well without oil; which is an important consideration. But the most general objection urged against the pocket chronometer, is, its liability to set, from being jolted, by riding on horseback, or otherwise. This is owing partly to the loaded balance, but mainly to the improper manner in which the scapement is arranged. I have seen many of them with the under pallet placed considerably out from the stem of the balance pinion; and the same pallet also stood so far round from the feather spring, when at rest, that it required a shake, throwing the balance through nearly half a circle, to start the chronometer; and its whole action, when going, did not reach a revolution. Such a watch could not, perhaps, be carried by an active person a single week, without stopping. This is an error of application, not of principle. The three pallets of a chronometer, together with the feather spring, can be so arranged, as that, by shaking the balance through *one-tenth* of a circle, the instrument will start. I have altered them to *one-eighth*, which is done by simply turning round the under, or striking off, pallet, so that, when the hair spring is at rest, that pallet will stand nearly parallel to the feather spring; then, by arranging the other parts, so that the scapement will act properly in accordance, a very slight motion will start the chronometer. With an *unloaded* balance, and a force of main-spring, equal to what is usually put into the lever, the vibration will, probably, reach a revolution and a third. What jolt, then, can possibly check such an action to the *tenth*, or even the *eighth*, of a circle?

BENJ. F. BAKER.

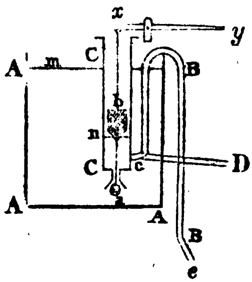
April 9th, 1827.

Description of an improved Syphon, and a Self-regulating Water Gate, for obtaining a regular and equable supply of Water, from Reservoirs, for Canals, and for other purposes. By S. H. LONG, *Colonel of Topographical Engineers.*

TO THE EDITOR OF THE FRANKLIN JOURNAL.

SIR—I take the liberty to communicate, for publication in your highly useful magazine, should you think it worthy of a place, a brief description of an improved Syphon, and Self-regulating Water Gate; either of which may prove serviceable, in draining water from reservoirs, for the supply of canals, and in other cases, where a regular and equable discharge of water is required. The plans under consideration, being analogous, and requiring nearly the same ad-

justments, a single figure, only, is sufficient to illustrate, respectively, their construction, and their mode of operation.



Let A, represent a cistern, or reservoir, filled with water to any height, as indicated by the dotted line at *m*, the contents of which are to be discharged agreeably to the plans suggested. B, a syphon, passing over the side of the reservoir, and communicating with a vertical trunk, placed within it. C, the trunk, of a diameter much greater than that of the syphon, and communicating with the latter, at *c*. The trunk is sustained in its vertical position, by supports attached to the side of the reservoir. At its lower extremity, is an orifice, of about the same diameter as that of the syphon, having a direction corresponding to that of the axis of the trunk. Within the trunk, is a float, or buoy, *b*, which must be allowed to move freely within it. The buoy is connected to a valve, or gate, *a*, of a globular or conical form, by means of an inflexible rod, or stem, of such a length as to allow the buoy to rise a little above the mouth of the syphon, at *c*. The valve, *a*, may be so adjusted, as to close the orifice at the bottom of the trunk, whenever the buoy is elevated to the top of its range, in order to intercept the discharge of the water, as occasion may require. To facilitate this operation, let a rod, or chain, *bx*, and a lever, *xy*, connected by the former, to the buoy, be appended to the apparatus, in any convenient manner, and the communication may be opened, and intercepted, at pleasure.

The operation will be as follows, viz. The trunk, C, and syphon, B, being filled with water, and the stopper removed from the end of the syphon, at *e*, the buoyancy of the water in the trunk, acting upon the buoy, *b*, will force the valve, *a*, into close contact with the rim of the orifice, at the bottom of the trunk, thereby preventing the admission of water, from the reservoir. As the water passes through the syphon, the trunk will be gradually exhausted, till the surface of the water contained in it, descends to *n*; when the buoy, being no longer sustained by the water, will act upon the valve, *a*, in such a manner, as to open the communication between the reservoir and the trunk. The water will now enter the trunk, through the orifice in its bottom, and the supply thus afforded, will correspond to the quantity discharged through the syphon.

In reference to the other modification, viz. the self-regulating gate,

the apparatus is similar, in all respects, to that just described, except that, instead of a syphon, a tube, or trunk, of about the same size as represented at cD, is to be substituted, communicating with the vertical trunk at *c*, and leading through the side of the reservoir, in a direction, horizontal, or inclining downward. The operation in this case, is so directly analogous to that in the former, as to require no further illustration.

I am, sir, &c. S. H. Long.

April 20*th*, 1827.

FOR THE FRANKLIN JOURNAL.

On the effect of Heat, in facilitating the cutting of a Razor.

Mr. Editor—It has been asked, in several of the English Mechanics' Magazines, "Why does a razor cut best, after dipping in hot water?" to which I have seen no satisfactory answer, though many attempts have been made. One considers the edge of a razor as toothed like a saw, and the expansion of the steel, by heat, to have some unaccountable effect on these teeth. Another, found that the heat of a coal fire would do as well as that of hot water; and another pretends to discredit the fact altogether. May not this question be partially answered, by asking another, Why does a hot knife, cut butter easier than a cold one?

Let any one shave with a cold razor, and examine it before wiping, he will perceive a wall of wax-like matter along the edge, which limits its free action to a mere line, similar to the edge of a double-iron plane; this wall is made soft by heat, and is removed by each succeeding cut. A razor, then, in addition to its property of cutting the beard freely, requires that of discharging the adhesive matter scraped up from the skin; this last property is very conveniently acquired, by dipping in hot water.

Yours, &c. Cogitator.

Remarks by the Editor.—We have long been convinced, that the cause assigned by *Cogitator*, is the true one, and have repeatedly given a similar solution. We have also met with the same explanation in one of the English journals, probably in the London Mechanics' Magazine. In order to test its truth, we have shaved with a cold razor, which, during the operation, was repeatedly dipped into cold water, and wiped upon a napkin, and are certain, that the keeping of the edge clean in this way, was advantageous. With respect to those who have doubted the correctness of the opinion, that warmth facilitates the cutting of a razor, we think that they have neither tender chins, nor stiff beards; otherwise, their doubts would have been removed with the removal of the latter.

The communication of *Cogitator*, has been for some time in our possession, but was mislaid, or it would have received an earlier insertion.

Animadversions on some Remarks upon Friction, in the description of Thomas's Marine Rail-way.

TO THE EDITOR OF THE FRANKLIN JOURNAL.

SIR—On looking over the description of Mr. Thomas's marine rail-way, in the Franklin Journal, my attention was arrested by the remark upon friction; "however true, theoretically," says the author, "that the friction must be diminished by large wheels and small axles, yet in the treatises of both Tredgold and Wood, it is admitted to be so inconsiderable, that the principle is established in practice, that the friction is as the weight—velocity does not increase it," &c. As I did not happen to coincide in that opinion, I immediately looked for the usual "remarks by the editor," which, by the by, I always read with peculiar satisfaction, but finding him silent, and, certain that he had not been napping, I concluded that I had been in error, and that *theory* and *practice* were never lawfully joined together. I therefore soon reasoned myself into the belief that friction wheels, might have their axles larger, even, than the *wheels* themselves.

It is a law of friction, that it exerts a constant force for all velocities;* now, as the degree of force expending, is the same for all velocities, both in the action and reaction, it follows, *that the whole amount of moving power expended, is as the time elapsed*, and that the weighing machine, or any fixed point that sustains the re-action, is under the same expense of power, since the time is the same, at both ends of the draft.

Were the position assumed by Mr. S. correct, we might find the quantity of metal in a piece of wire, if of uniform thickness throughout, by multiplying the area of the section, by the time of running the length of it, without regard to velocity. If such be the fact, it remains inexplicable how the use of friction wheels, came to be introduced at all, since there is not, *even in theory*, a good reason for it. But, after all, sir, I fancy that at least one half of our learned philosophers, will doubt the truth of this astonishing doctrine.

I am, sir,
Most respectfully yours, &c.
AN OPERATIVE MECHANIC.

Remarks by the Editor.—The remarks of Mr. Sullivan upon friction, to which our correspondent alludes, will be found in page 81 of this volume; it appears to us, that they are incorrect; as we think that not only theory, but practice, uniformly leads to the conclusion, that the effect of friction is diminished, in a very considerable degree, by large wheels, and small axles. It is fully admitted, that the retarding force of friction, is as the load, (nearly,) *all other*

* This has been most satisfactorily shown, by *weighing* the *re-action* which is in all cases equal, in point of energy, to the action, and therefore its just representation. See London Mechanics' Magazine, experiments by Roberts.

circumstances remaining the same. TREDGOLD, and WOOD, are referred to, as authorities to prove that the size of the wheels is unimportant; we have again looked into their treatises on rail roads, and do not understand them, if they justify the assumption, that the resistance is not considerably lessened, by the employment of large wheels.

We did intend, to have given in the present number, a more extended article upon this subject, but find that we have now neither time, or room, and therefore defer it until another opportunity; we have detained 'An Operative Mechanic,' that his letter, and our remarks might accompany each other, but as we are very anxious to encourage our *operatives* to write, we give a place to his communication, although we must reserve our own observations for a future period.

PERKINS'S STEAM ENGINE.

PUBLIC expectation has been kept so long on tiptoe, to view the promised results from this "*miracle of arts,*" and hope has been so long deferred, that it would be matter of surprise, were not all new promises upon the subject, listened to, very doubtingly. We present to our readers, the two following articles, which are the most recent we have seen upon this subject, and which, it will be perceived, are written in a tone of great caution. For ourselves, we never looked for the fulfilment of the promises which were at first made, because we knew of no principle, in mechanical or chemical philosophy, upon which they could be sustained; and in these principles, we were not prepared for any sudden and great revolutions. [*Editor.*

So much has been said by us, and reiterated by our contemporaries, relative to Perkins's projected improvements on the steam engine, and so little produced, of a nature calculated to satisfy public expectation, that it is with no small degree of diffidence we again mention the subject. We consider, however, that it is our duty, as public journalists, and particularly so, as standing foremost in the ranks of mechanical science, to present our readers with every glimmer of light, that may afford the prospect of rekindling the embers of this important subject.

Mr. Perkins has now completed an engine, which he represents as embracing the ultimatum of his present intentions, and which is designed to show the absolute realization of his anticipated hopes, or their decided failure. We should, however, observe, that the possibility of the latter, Mr. P. has never for a moment admitted, and now considers that he has only perfected those plans he contemplated from the first, and which required but patience and time, to bring to maturity.

The very transient view of the engine, which we have been enabled to take, precludes the possibility of our describing its construction; besides, we should, by so doing, anticipate a more perfect account,

which we hope to give, hereafter. There are many parts, which exhibit considerable novelty and ingenuity, and the whole is comprised in a very compact form. The power of the engine, which stands upon a base of about four feet square, is said to be capable of variation, from fifteen, to thirty horses, according to circumstances, connected with the economization of fuel. It has not yet been exhibited in operation, but that is expected to take place in a few days.

At present, we beg to be understood, as merely reporting progress, and not in any respect as venturing an opinion as to the result: we have only seen the engine for a few minutes, in a state of inertia; by the time of publishing our next number, we, probably, shall be in a situation to say something that may be satisfactory, if not final.

[*Lond. Journ. of Arts & Sciences.*

Perkins's high-pressure Engines.

A report has been made by M. Girard, on a memoir by Sir Wm. Rawson, on Perkins's high-pressure engines, read to the Academy of Sciences at Paris. The report, after enumerating the advantages, stated in the memoir to be possessed by the apparatus, observes, how desirable it would be, that these assertions should be supported by authentic experiments, which, it appears to them, they want at present, unless it be in the propulsion of balls, which comprises the whole of the official proofs. [*Bull Univ. p.* 257.

On the preparation of Hydraulic Cements. By General TREUSSART.

GENERAL TREUSSART, referring to some observations, published at St. Petersburgh, in 1822, by M. Raucourt, and to some experiments of his own, related, in a late number of the *Memorial de l'officier de Génie*, states, that he has, since then, established an important fact, which he had previously been led, by Raucourt's remarks, to anticipate, with regard to the preparation of artificial pozzolan-mortar, or hydraulic cement; namely, that the access of air, during the calcination of the argillaceous cement, is of great consequence to the tenacity of the mortar, and the quickness with which it hardens. He first refers to his former experiments, (which we have not yet seen,) as proving, that, contrary to what is generally supposed, neither the oxide of iron, nor that of manganese, nor magnesia, can communicate to lime, the property of hardening under water. He then observes, that, on calcining an argillaceous earth, procured near Frankfort, (and consisting of silica and alumina, a 66th part of magnesia, and a trace of iron,) and mixing it with half its weight of lime, to form a mortar, he found, that, if it had been calcined under free exposure to the air, it hardened under water, in two or three days; and, at the end of a year, required a weight varying from 390 to 530 pounds to break it; while, if the clay had been calcined out of reach of the air, the mortar took thirty days to harden, and broke with a weight of 40 or 50 pounds. Analogous results were obtained with a clay from

Holzheim, near Strasburg; and in this instance, he also found that it was useful to mix a fiftieth part of lime with it, before calcination. It is not easy to account for these differences; but the general himself, is disposed to ascribe them to the absorption of oxygen, by the alumina. In proof of this, he mentions, that the same difference is observed, if, instead of impure clay and lime, the purest alumina, and the lime of white marble, be employed. The alumina, when calcined under a current of air, makes a mortar which hardens sooner, and is much stronger, than when the calcination is conducted in a close furnace. Another fact in support of his conjecture, is, that alumina, when calcined in the air, dissolves more easily in sulphuric acid. The results of his latest investigations, are, that the clay to be chosen for the best hydraulic mortars, should contain a little lime; that it should be calcined under exposure to a current of air, contrived according to the nature of the furnace; that, after being reduced to a fine powder, it should be mixed with paste of lime, in the proportion of one of the latter, to two, or two and a half, of the former: that the mortar should be kept for ten or twelve hours before it is used, in order to acquire a certain degree of consistence; and that it may be perfectly relied on, if, by a preliminary trial, it is found to harden in three or four days; his experience having invariably shown, that the mortars which harden soonest, are also the most tenacious.—*Annales de Chimie et de Physique, Mars*, 1826.

Composition for the Covering of Buildings, by M. Pew.

The composition proposed by the author, is destined to form a sort of unalterable, and incombustible mastich. For this purpose, he takes the hardest, and the purest limestone that he can find, free from sand, clay, or other heterogeneous matter. White marble is to be preferred, if it can be procured. The limestone is calcined in a reverberatory furnace; it is then pulverized, and passed through a sieve. One part is taken by weight, and mixed with two parts of clay, well baked, and similarly pulverized. This mixture must be made with great care. On the other hand, one part of calcined and pulverized sulphate of lime (gypsum,) is taken, and two parts of clay, baked, and pulverized, added to it. These two sorts of powder are then combined and incorporated, so as to produce a perfect mixture. The composition is preserved for use in a dry place, sheltered from the air, where it keeps for a long time, without losing its properties. When it is to be used, it is mixed with about a fourth part of its weight of water, which is gradually added, stirring it continually, until it forms a thick paste. This paste is spread upon the laths, and joists of buildings, which it renders entirely incombustible. It becomes, in time, as hard as stone; allows no moisture to penetrate, and is not cracked by heat. When well prepared, it will last for any length of time. The composition, when still in a plastic state, will receive whatever colour it may be thought proper to give it.

Strong Leather for Harness, and other Saddlery work.

In Poland, and Russia, the twisted leather which they make themselves, is preferred to every other kind, for harness. For making this leather, dried cow-hide is taken; the hair is removed by means of boiling water, and a sort of scraper; it is then cut into long straps, which are sewed, end to end; the two extremities of the long strap thus formed, are then stretched together, and the strap thus becomes double. In this state, it is impregnated with fatty substances, made warm; it is then suspended by a hook, to the roof, and weights attached to its lower part. In this manner, the strap forms two parallel bands, placed in a vertical position, and united above and below. Two sticks are passed between them, crossed horizontally; and they are twisted, and pressed against each other, as strongly as possible; and when the moving power ceases, they turn of themselves in the opposite direction. During this operation, the leather is very sensibly heated; fatty substances are then applied to it anew, with which it is fully impregnated, and at length acquires an extraordinary degree of pliancy. The leather thus prepared, lasts for a very long time, and preserves its qualities in all sorts of weather.

Bull. Univ. August, 1825.

Cows, Horses, and Sheep, fed on Fish, in Persia.

The cows have humps, and resemble those of India; milk, butter, and ghee, are very abundant, and good of their kind. This is the more remarkable, as the cattle have but little pasture in the neighbourhood of the town; and it is certain, that one chief article of their food is *dried fish*, a little salted; the cattle become very fond of this, which, with pounded date-stones, is all they get to eat for a considerable portion of the year. The natives assert, that, so far from the milk being spoiled when the cattle feed on these things, they drink much more water, which increases both the quantity and quality of the produce. Horses, and sheep, as well as cows, are fed on this diet, and thrive equally well upon it. [*Fraser's Travels.*

Manufacture of a Paper, which has the property of removing Rust from articles of Iron and Steel.

After having dried a certain quantity of pumice among live coals, and reduced it to powder, grind it with linseed oil varnish, and then dilute it with the same varnish, until it be thin enough to be laid upon paper, with a pencil. To give this layer a yellow, black, or brownish-red colour, the mass is mixed, before applying it to the paper, with a little ochre, English red, or lamp-black. Care must be

taken to lay the substance on as equally as possible, and to dry it in the air. When the first coat, thus applied to the paper, is dry, another is to be laid on, in like manner. Those who manufacture it for sale, pass the paper, thus prepared, under a cylinder, to render it smooth. It is further to be observed, that the mass must be liquid, and that it must be stirred about, before applying it to the paper.

LIST OF PATENTS IN ENGLAND.

Which passed the Great Seal in December, 1826.

To John Costigan, of Collon, in the county of Louth, in that part of the United Kingdom, called Ireland, civil engineer, for his invention of certain improvements in steam machinery or apparatus—18th December.

To Peter Mackay, in the county of Surrey, gentleman, in consequence of a communication made to him by a foreigner residing abroad, that he is in possession of an invention of certain improvements by which the names of streets and other inscriptions will be rendered more durable and conspicuous—18th December.

To William Johnson, of Droitwich, in the county of Worcester, gentleman, for his invention of certain improvements in the mode of process, and form, of apparatus for the manufacturing of salt, and other purposes—18th December.

To Maurice De Iongh, of Warrington, cotton spinner, for his invention of certain improvements in machinery or apparatus for preparing rovings, and for spinning, twisting, and winding fibrous substances—18th December.

To Charles Harsleben, in the county of Middlesex, Esq. for his invention of certain improvements in constructing or building of ships, and other vessels, applicable to various useful purposes, and in machinery for propelling the same—20th December.

To Thomas Quarrill, in the city of London, lamp-manufacturer, for his invention of certain improvements in the manufacture of lamps—20th December.

To William Kingston, master mill-wright, and George Stebbing, mathematical instrument maker, of Portsmouth, for their invention of certain improvements on instruments or apparatus for the more readily, or certainly, ascertaining the time and stability of ships and other vessels—20th December.

To Melvil Wilson, in the city of London, merchant, in consequence of a communication made to him by a certain foreigner residing abroad, he is in possession of an invention of certain improvements in machinery for cleaning rice—20th December.

To Charles Seidler, in the county of Middlesex, merchant, in consequence of a communication made to him by a foreigner resident abroad, for having discovered a method of drawing water out of mines, wells, pits, and other places—20th December.

To Frederick Andrews, in the county of Essex, gentleman, for his invention of certain improvements in the construction of carriages, and in the engines, or machinery to propel the same, to be operated upon by steam, or other suitable power, which engines or machinery are also applicable to other purposes—20th December.

To Charles Random Baron de Borenger, of the county of Middlesex, for his having discovered and invented certain improvements in gunpowder-flasks, powder-horns, or other utensils, of different shapes, such as are used, or can be used, for the purpose of carrying gunpowder therein, in order to load therefrom, guns, pistols, blunderbusses, and other fire-arms—20th December.

To Valentine Bartholomew, in the county of Middlesex, gentleman, for his invention of improvements in shades for lamps, and other lights—21st December.

To John Gregory Hancock, in the county of Warwick, plated beading and canister-hinge manufacturer, for his invention of a new elastic rod, for umbrellas and other the like purposes—21st December.

French Patents, 1826.

To A. Dutertre, Paris, for his invention of a new instrument to the use of sight. 9th June—15 years.

De Bugury, and Bernhardt, Paris, for their invention and importation of a certain process to produce artificial leather. 16th June—10 years.

Baroness de Gavedell-Geanny, Paris, for her importation and improvement of manufacturing bricks by machinery. 16th June—15 years.

V. L. Simonard, Lyons, Department Rhone, for his addition and improvement to his patent for a mechanical process of driving boats up the river by the current. 21st Dec. 1825—15 years.

G. Hunter, Paris, for his invention of a carriage, carrying its own iron rail road. 16th June—15 years.

P. Fouquier, Roubaix, for his invention of a manufacturing weaver combs of steel. 16th June—5 years.

J. B. V. Buisson, Paris, for his invention of a process for bleaching and washing linen by steam. 16th June—10 years.

B. Laboyer de St. Gervaix, Paris, for his invention of a machine he calls "Voltige." 16th June—10 years.

C. P. Antheaum, Rouen, Department Seine inferieure, for his invention to sew, mechanically, shoulder straps, &c. 26th June—5 years.

L. Baron, Nimes, Department Gard, for his improvement and addition to his patent of invention for a distilling apparatus. 23d June—5 years.

H. Bruguiere, Nimes, Department Gard, for his invention of improvements to M. Derosnes' distilling apparatus. 23d June—5 years.

P. Daste, Condon, Department Gers, for his invention of a machine to grind corn. 23d June—5 years.

P. Vital, Paris, for his invention of a process to learn to write in a short time. 23d. June—5 years.

A. N. Lithomond, Paris, for his invention of a process to manufacture artificial marble, stone, and ornaments thereof. 23d June—15 years.

M. Poole, London, for his invention to tan leather by the compression of the atmosphere. 23d June—15 years.

J. Hayward, Paris, for his invention of a new apparatus to filter and clarify sirups, &c. 23d June—5 years.

E. Fessart, Paris, for his invention of a tool to clean bottles. 30th June—10 years.

J. Suttil, London, for his importation of a set of machinery to spin hemp, flax, &c. 30th June—15 years.

A. Brouguiers, La Rochelle, Department Charente inferieure, for his improvement and additions to his patent for a distilling apparatus. 11th Dec. 1817—10 years.

NOTICES.

Eau de Javelle.—This liquid, which is mentioned in the article on the "Manufacture of Catgut," &c. is a weak bleaching liquor, employed in Paris, not only in manufactories of several kinds, but also in domestic economy. The bleaching salts (chlorate of lime), made and sold in this city, may be used wherever a liquid similar to the *eau de Javelle* is wanted, and it may be graduated to any desired strength.

The article on Japanning and Varnishing, which has been omitted in several numbers, we hope to resume in the next.

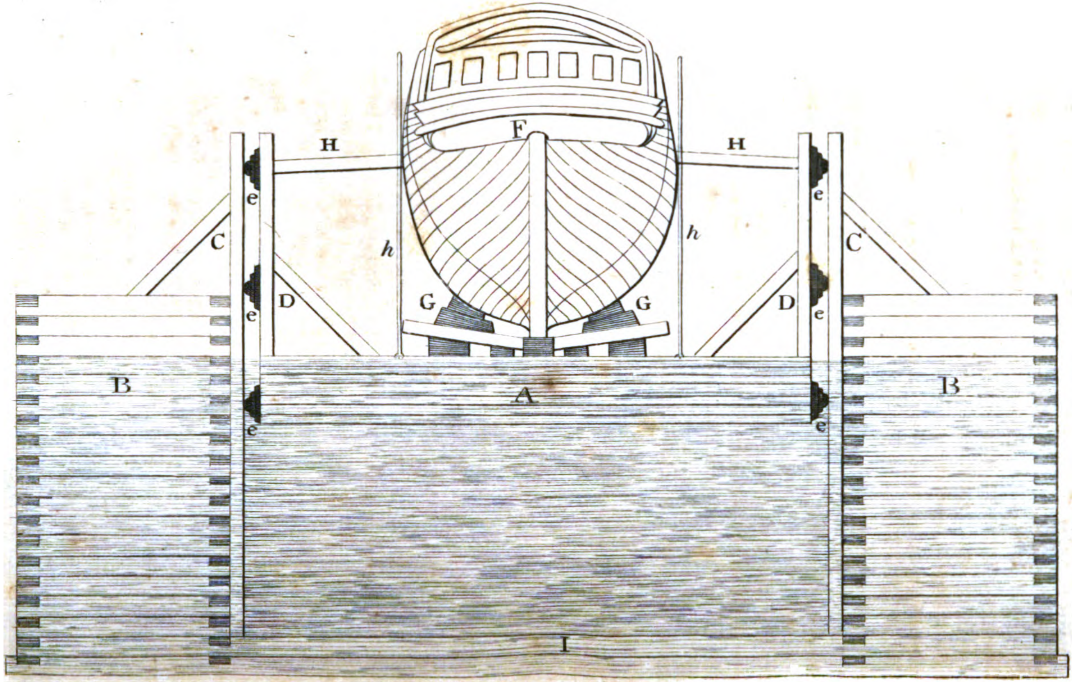
We had prepared an article on the Baltimore Rail Road, and the Pennsylvania Canal, but our forms were filled, and it has been crowded out.

It has been suggested, that it would be an improvement, to place the titles of the respective articles at the head of each page, instead of the present running title; we will adopt this plan at the commencement of the next volume.

Errata.—In page 286, of this number, line 18, from the bottom, for "the plan of forming," read *other modes of forming*. In the same line, after "connexion," insert *were suggested.*

For Abraham Pennock, read Abraham L. Pennock.

FLOATING DRY DOCK, BY EDWARD CLARK.



W. Hooker Engraver & Printer N. York 1827.

THE

FRANKLIN JOURNAL,

AND

AMERICAN MECHANICS' MAGAZINE;

DEVOTED TO THE USEFUL ARTS, INTERNAL IMPROVEMENTS, AND GENERAL SCIENCE.

JUNE, 1827.

On House Painting.

House Painting is an art of great antiquity, and it is more than probable, that the earliest erections, of a durable nature, received some additions from the pencil of the artist. Painting, as applied to buildings, comprises, in the first place, the colouring of wood, iron, &c.; and to effect this, a pigment is spread over them with a brush, so that, by a repetition of several coats, the material is preserved, and its appearance improved.

The object of this division of our work, is to give an account of some mechanical proceedings in certain kinds of painting, calculated to preserve and embellish the walls of houses, and furniture. This branch of the art, extends to every part of architecture. The whole building becomes the workshop of the artist; the stairs, the balustrades, the sashes, the doors, and the railing of all kinds, occupying his first care, and then the ceilings and wainscoting.

The artist gives to all his subjects, a chosen and uniform tint; but he has it in his power to vary the colours on different parts of the building, in such a manner as to produce the most pleasing effect.

Among the utensils of the painter, it is needless, but for rendering the article complete, to mention brushes and pencils, of all sizes, as absolutely necessary.

The brushes are made of boars' bristles, or of hair, with a mixture of bristles; they ought to be straight, very smooth, and of a round form. Half an hour before they are used, it is proper to soak them in water, in order to swell the wood of the handle, and prevent the hairs from falling off; after this, they may be applied to all purposes, either in water colours, or in oil: but it may be observed, that for the former, they require less softening.

The pencils are made of badgers' hair, or any fine hairs, encased in the pipes of quills of all sizes.

The vessel wherein the pencils are cleansed, is made of copper or of tin, smooth below, rounded at the ends, and divided into two parts by a thin plate in the middle. The oil, or the substance with which the pencil is cleansed, is contained in one of the divisions.

The palette is made of the wood of the pear or apple tree, of an oval, or a square shape, very slender, but somewhat thicker at the centre, than at the extremities. A hole is made in one of its sides, sufficiently large to admit the thumb of the workman.

When the palette is new, it is covered with oil of walnuts; and as often as it dries, the operation is repeated, till it be fully impregnated; it is afterwards polished, and finally rubbed with a piece of linen, dipped in oil of common nuts.

The painter's knife, is a thin, flexible plate, equally slender on both sides, rounded at one extremity, and the other fixed into a handle of wood.

All the vessels employed to hold the colours, should be varnished; a precaution necessary to prevent their drying too quickly; and they may be cleansed with a piece of marble, or any hard stone, by means of water, oil, or essence.

To grind, is to reduce to powder, the substances which give colours; and to dilute, is to impregnate a liquid, with a tint, in such a manner as to make it capable of being applied by a brush.

When the materials are ground in water, it is proper to dilute them, in size made from parchment. If they are diluted by spirit of wine, there must be no more diluted than what serves the immediate occasion, as colours prepared in this manner, dry very rapidly.

Colours ground in oil, are sometimes diluted with pure oil, more frequently with oil mixed with essence, and commonly with the simple oil of turpentine; the essence makes the colours easy to work.*

When colours are ground with the oil of turpentine, and diluted

* Oil of turpentine, or, as it is called, *turps*, is in general use in house painting, and is the ingredient by which the flatting, as it is termed, is performed. All the larch and fir-trees furnish a resin, known by the general name of turpentine. Commerce distinguishes several qualities according to its degree of goodness. The larch-tree furnishes what is called Venice turpentine; it is obtained by being made to flow from the trunk of the tree, through holes made with an auger, in which small pipes are fixed, that conduct the juice into buckets placed to receive it. This turpentine has a yellowish and limpid colour, a strong aromatic smell, and bitter taste. In Canada, the peasants collect it from the fir-tree by perforating the sacs, which contain it under the bark, with the point of a horn which is filled with this juice. It is afterwards distilled, on which it liberates an oil more or less volatile, according to the degree of heat employed. When the operation is done by a bath, a white, limpid, and odoriferous oil is obtained, which is called essence of turpentine. The residue from this distillation, forms the boiled turpentine of commerce. This is sold at the colour shops, in the same way in which oil is, viz. by the gallon. This, as well as the oil, considerably improves by age: hence all painters, in a large way of business, keep it by them in quantities, which enables them to depend on their work retaining its colour: a circumstance of no little importance in our present mode of house painting.

in varnish, as they require to be immediately applied, it is necessary to prepare a small quantity at a time. This preparation of colours, gives greater brilliancy, and dries more speedily, than those prepared in oil; but they require more art to manage them.

They grind colours, or coloured substances, with a mullar, which is employed on the stone, till they become a very fine powder. The operation is facilitated by moistening them, from time to time, with a little water, and by collecting them under the mullar, with the knife. They are afterwards laid in small heaps on a sheet of white paper, and allowed to dry, in a situation not exposed to dust. Those who grind white lead, have a stone for that purpose only, as this colour is very easily tarnished. In executing this part, well, it is necessary to grind the colours equally, and moderately; to grind them separately, and not to produce a tint by mixture, till the colours are well prepared.

Dilute no more, at a time, than what you have occasion to employ, to prevent them from growing thick.

In grinding the colours, put in no more liquid than what is necessary to make the solid substances yield easily to the mullar: the more the colours are ground, the better they mix, and give a smoother and more agreeable painting.

It is also necessary to give all attention to the grinding and diluting of colours, that they may be neither too thick, nor too thin.

Prepare only the quantity necessary for the work you undertake, because they do not keep, long; and those which are newly mixed, are more vivid, and beautiful. Hold the brush straight before you, and allow only the surface to be applied to the subject; if you hold it inclined in any other direction, you will run the hazard of painting unequally. It is necessary to lay on the colours boldly, and with firm strokes; taking care at the same time, to spread them, equally over the surface, and not to fill up the moulding, and carved work. If this accident should happen, you must have a little brush to clean out the colours. Stir them frequently in the vessel, that they may preserve always the same tint, and that no sediment may remain at the bottom. Take care not to overcharge the brush with the colour. Never apply a second layer, till the first, or preceding one, be perfectly dry; which it is easily known to be, when, in bearing the hand gently over it, it does not adhere. In order to render this drying, more speedy and uniform, always make the layers as thin as possible. Before painting, it is necessary to prime the subject; that is, to give it a layer of size, or of white colouring oil, to fill up the pores, and render the surface, smooth: by this means, fewer layers of colour, or of varnish, are afterwards necessary. Every subject to be painted, or gilt with leaf gold, ought to have, first, a white ground; this preserves the colours fresh and vivid, and repairs the damage which they occasionally receive from the air.

To paint in water-colours, which, from its simplicity, should first occupy the artist's attention, is to do it in those which are ground in water and diluted in size. There are three kinds, of this painting; namely, the *common*, the *varnished*, and that which is called *king's*

white; but before entering on these, it is necessary to make some preliminary observations.

1. Take care that there be no grease on the subject; and if there be, scrape it off, or clean it with a lye, or rub the greasy part with garlic and wormwood.

2. Let the diluted colour, fall in threads from the end of the brush when you take it out of the vessel; if it adheres to it, it is a proof that it wants size.

3. Let all the layers, especially at the beginning, be laid on very warm, provided that the liquid be not boiling, which would effectually spoil the subject; and if on wood, expose it to crack. The last layer, given immediately before the varnish, is the only one which ought to be applied, cold.

4. In very fine work, where it is necessary to have beautiful and solid colours, the subjects are prepared by size, and proper whites, which serve as a ground to receive the colour, and render the surface very equal, and smooth.

5. Whatever colour is to be laid on, the white ground is the best, as it assimilates most easily with the painting, which always borrows something of the ground.

To make the following details sufficiently plain, we shall take the measures, to which the quantity of colours are applied, at fathoms; that is to say, six feet in height, by six feet in breadth. We shall afterwards fix the quantity of materials, and of liquids, necessary to cover this surface. This, however, cannot be exactly defined; as some subjects imbibe the colours much more than others. The manner of employing them, also makes a difference; as habit, enables one to manage them to greater advantage, than another. And it is also to be observed, that the first layer will consume more than the second; and that a prepared subject, requires less than one which has not been so.

When we speak of a fathom, it must be understood of a smooth and equal surface; for if the wood is varied with mouldings and carving, there must be a difference in the quantity of colours. In general, it requires about a pound of colours, to paint a square fathom, in water-colours. In making up this quantity, take three-fourths of colours, ground in water, and to this add about six ounces of size, to dilute it.

Works which require no great care, or preparation, as ceilings and stair-cases, are generally painted in common water colours, *i. e.* with earths infused in water, and diluted in size.

For a common, white kind of this painting, steep Spanish white moderately pounded, in water, for two hours. Infuse a proper quantity of the black of charcoal, in water, for the same space of time: mix the black and white in the proportion that the tint requires; afterwards mix them up with a pretty strong size, sufficiently thick and warm, and apply them to the subject, in as many layers as may be thought necessary. It requires about two pounds of white, in a pint of water, and a quantity of black, in proportion to the tint, together with a part of size, to cover a square fathom. If this be employed

on old walls, they must be well scraped, the dust brushed off with a hair broom, and washed, carefully, with lime water. If on new plaster, the colours require more size.

All kinds of colours may be ground in water only, when the tint is made; and when they have been infused in water, they must be mixed up with size.

The white *des carmes* is a manner of whitening interior walls, whereby they are rendered extremely beautiful. To effect this, procure a quantity of the very best lime, and pass it through fine linen; pour it into a large tub, furnished with a spigot, at the height equal to that which the lime occupies: fill the tub with clear spring-water; beat the mixture with instruments of wood, and then allow it to settle for 24 hours.

Open the spigot, allow the water to run off, supply the tub with fresh water, and continue this operation for several days, until the lime receives the greatest degree of whiteness.

When you allow the water finally to run off, the lime will be found in the consistency of paste; but with the quantity you use, it is necessary to mix a little Prussian blue, or indigo, to relieve the brightness of the white, and a small quantity of turpentine, to give it brilliancy. The size proper for it, is made of glove-leather, with the addition of some alum; and the whole is applied with a strong brush, in five or six layers, to new plaster.

The wall is rubbed over, strongly, with a brush of hog's bristles, after the painting is dry; which gives it its lustre and value, and which makes it appear like marble or stucco.

Badegeon is a pale yellow colour, applied to plaster to make it appear like free stones. It gives to old houses, and churches, the exterior of a new building, by assuming the colour of stones newly cut. Take a quantity of lime, newly slaked; add to it the half quantity of what the French call *sciure de pierre*, in which you have mixed a quantity of the ochre of *rue*, according to the colour of the stone you intend to imitate. Steep the whole in a pail of water, in which is melted a pound of rock alum. When the *sciure de pierre* cannot be obtained, it is necessary to use a greater quantity of ochre *de rue*, or of yellow ochre, or grind the scales of the stone de St. Leu; pass it through a sieve; and along with the lime, it will form a cement, on which the weather will scarcely make any impression.

When the ceilings or roofs are new, and you wish to whiten them, take white of Bougival, to which add a little of the black of charcoal, to prevent the white from growing reddish: infuse them, separately, in water; mix the whole with half water, and half size of glove-leather, which, being strong, would make the layer come off in rolls, if it were not reduced with water. Give two layers of this tint, while it is lukewarm. If the roof has been formerly whitened, it is necessary to scrape to the quick, all the remaining white; then give it two or three layers of lime, to ground, and whiten it. Brush it carefully over, and give it two or three layers of the white of Bougival, prepared as before.

To finish the fire-places, clean them with a very strong brush, and

carefully rub off the dust and rust; pound about a quarter of a pound of lead ore into a fine powder, and put it into a vessel with a half pint of vinegar; then apply it to the back of the chimney with a brush: When it is made black with this liquid, take a dry brush, dip it in the same powder without vinegar, and dry and rub it, with this brush, till it become shining as glass.

The advantages of this kind of painting, are, that the colours do not fade; that they reflect the light; that they give no offensive smell, but permit the places to be inhabited as soon as finished; and that the varnish preserves the wood from insects, and moisture.

To make a fine varnish on water-colours, seven principal operations are necessary; namely, to size the wood, to prepare the white, to soften and rub the subject, to clean the moulding, to paint, to size, and to varnish.

To size the wood, is to give one or two layers of size, to the subject which you intend to paint. To make which, in the most perfect manner, take three heads of garlic, and a handful of wormwood leaves; boil them in three pints of water, till they are reduced to one; pass the juice through a linen cloth, and mix it with a pint of parchment size; add half a handful of salt, and half a pint of vinegar; and boil the whole on the fire.

Size the wood with this boiling liquor; allow it to penetrate into the carved and smooth places of the wood, but take care, at the same time, to take it as clean off the work as possible, or, at least, to leave it at no one place thicker than at another. This first sizing, serves to fill up the pores of the wood, and to prevent the materials afterwards from collecting in a body, which would cause the work to fall off in scales.

In a pint of strong parchment size, to which you have added four pints of warm water, put two handfuls of white Bougival, and allow it to infuse, for the space of half an hour; stir it well, and give a single layer of it, to the subject, very warm, but not boiling, equally and regularly laid on, and dashed with repeated strokes of the brush, into the mouldings and carved work.

To prepare the white, take a quantity of strong, parchment size, and with the hand, sprinkle lightly over it, Bougival white, till the size be covered with it, about half an inch in thickness; allow it to soak, for half an hour, as near the fire as to keep it milk warm; and then stir it with the brush till the lumps are broken, and it be sufficiently mixed.

Give seven, eight, or ten layers of this white, or as many as the nature of the work, or the defects in the wood, shall render necessary, giving more white to the parts which require to be softened; but, in general, the layers must be equal, both with regard to the quantity of the white, and the strength of the size.

The last layer of the white, ought to be clearer than the rest, and is made so by adding water. It must be applied more slightly, taking care, with small brushes, to cover all the difficult places in the mouldings and carved work. It is necessary also, between the drying of

the different layers, to fill up all the defects with white mastich and size.

The work being dry, take little pieces of white wood, and of pumice-stone, ground for the purpose into all necessary forms, either for the panels, or the mouldings. Take cold water, (heat being destructive of this kind of work, it is common in summer, to add a little ice;) soften the wall with a brush, but only as much, at a time, as you can easily work, as the water might dilute the white, and spoil the whole; then smooth, and rub it with the pumice-stones, and the small pieces of wood: wash it with a brush as you smooth it, and rub it over with a piece of new linen, which gives a fine lustre to the work.

The mouldings, and carved work, are cleaned with an iron knife; and the only thing to be attended to, in the operation, is not to raise the grain of the wood.

The subject, thus prepared, is ready to receive the colour you intend to give it. Choose your tint; suppose a silver colour.

Grind white ceruse, and Bougival white, separately, in water, of each an equal quantity, and mix them together. Add a little blue of indigo, and a very small quantity of black of charcoal from the vine-tree, very fine, ground also separately, and in water; more or less of the one, or the other, gives the tint you require. Dilute this tint in strong parchment size; pass it through a bolting cloth of silk, very fine, and lay the tint on your work, taking care to spread it very equally; and then give it two layers, and the colour is applied.

Make a weak, beautiful, and clean size; stir it till it cools; strain it through a fine cloth, and give two layers to the work with a soft painting brush, which has been used, but which you have been careful to clean. Take care not to choak up the mouldings, nor to lay on the size, thicker on one place than another, and spread it over the work very slightly, otherwise the colours will be injured, and undulations in the painting will be the result.

The beauty of the work depends on this last sizing; for if any part is omitted, the varnish will penetrate into the colours and give it a darker shade.

When the sizing is dry, lay on two or three layers of spirit of wine varnish, taking care that the place on which you lay it, be warm, and the work is finished. [*Partington's Mechanic's Gallery.*

(TO BE CONTINUED.)

ON THE NATURE AND PROPERTIES OF TIMBER.

Extracted from "The Elementary Principles of Carpentry, by Thomas Tredgold."

[Continued from page 291.]

*Description of Woods.**

CLASS I.

THE first class contains all woods that have larger transverse septa

* As the species described by Tredgold, are not, in general, the same with those used in this country, we shall select a small part only of this article, with a hope that it may awaken attention to a subject which has been too much ne-

(silver grain.) The woods of this class, are compact, hard, and heavy; never very deep coloured, the oak being the darkest coloured of the class; they are nearly free from smell, and never resinous.

This class is formed into two divisions; one, containing those woods, in which the annual rings are distinctly porous on one side, and compact, or nearly compact, on the other; the other division, contains those in which the annual rings are sensibly uniform, and only to be distinguished by a difference of colour.

Division I.—In this division, I have only observed one species, the oak, which is universally allowed to be the best of woods.

1. Oak.—Of the oak (the *Quercus* of botanical writers) there are several species, which produce valuable timber. Vitruvius enumerates five kinds, viz. the esculus, the cerrus, the quercus, the suber, and the robur; the timber of each, being distinguished by its peculiar properties: but it would be difficult to identify some of the kinds mentioned by him, with the species described by botanical writers. Vitruvius, by his observations, shows that the qualities of the different species were attended to, and they must also have been well understood by the Gothic builders in this country, for in the roofs and beams of most of their buildings, we find a very superior kind of oak, which sometimes closely resembles, and is often mistaken for, chesnut. I have heard this kind of oak called the "Irish oak." Evelyn commends the Irish oak "for resisting the worm;" but to what species of oak he alludes, I have not been able to determine.

In general, the English oak is spoken of by practical men, as though there were but one species, and no difference in the quality of the wood, except that produced by soil and situation; but two distinct species have been long known to English botanists; and it appears from the observations and inquiries I have made, that the kinds which are common in different districts, are different species. I have not been able to extend my observations on this point, so far as I was desirous of doing, but as the different species differ materially in their properties, it is of national importance that the best species for ship-timber, should be most commonly cultivated; therefore I hope the investigation will be continued by some one more competent to the task.

Common British oak (*Quercus robur*) is found throughout the temperate parts of Europe, and is that which is most commonly met with in the woods and hedges of the south of England.

The leaves of this species are, irregularly sinuated, with short, or

glected by us, but which is beginning to force itself upon our notice, in consequence of the rapid decrease of some kinds of timber, which have been improvidently wasted, in our most populous districts. The period has arrived, when the relative value of the varied productions of our forests, whether employed for their beauty, strength, or durability, may be correctly estimated; most of our woods having been in use for a number of years, and in all the varieties of situation requisite to enable us to estimate the latter property. Our engineers, naval architects, and builders, might furnish individual observations, which, when collected and compared, would be invaluable.

The tabular experiments will serve to show the manner of presenting the result of observations on the strength of timber. [Editor.

scarcely any footstalks; the acorns have long stalks. In favourable situations, this species attains an immense size. A fine healthy tree, now growing (1820) in the grounds of Earl Cowper, at Panshanger, Herts, measures nearly 18 feet in circumference, at 5 feet from the ground; and the whole height of the tree exceeds 75 feet.

The wood of this species has often a reddish tinge; the larger septa are always very numerous, producing large flowers; the grain is tolerably straight and fine, and it is generally free from knots; sometimes closely resembling foreign wainscot. It splits freely, and makes good laths for plasterers and slaters; and it is decidedly the best kind of oak for joists, rafters, and for any other purposes where stiff and straight grained wood is desirable.

The sessile-fruited oak, bay-oak of Bobart, Norwood oak of Martyn (*Quercus sessiliflora*) is a native of the woods and hedges of the temperate parts of Europe, and appears to have been first noticed as a distinct species, in this country, by Mr. Bobart, in Bagley Wood, and near Newbury, in Berkshire. It has been observed by Miller, near Dulwich, in Surry; and it appears to be the common oak of the neighbourhood of Durham, and perhaps generally of the north of England.

The strength, elasticity, toughness, and hardness of the sessile-fruited oak render it superior for ship-building, but it is both heavier, and more difficult to work, than the robur; how far they may differ in durability, remains to be determined. The wood for the old *Sovereign of the Seas*, was from the north: is it not probable that the greater part of it was of the sessile-fruited oak? The hardness of the timber, "when taken in pieces after forty-seven years' service," is in favour of this conjecture.

In order to make experiments on the two species, when grown at the same place, and nearly of the same age, I was supplied with specimens by Mr. Atkinson.

The trees were cut a little before the fall of the leaf, and being cut into small scantlings, after drying two months, they were submitted to experiment.

The following table shows the results of trials on two pieces, each piece an inch square, and sustained by supports 24 inches apart, the weight being applied in the middle of the length.

Species of oak.	Specific gravity.	Weight of a cubic foot in pounds.	Comparative stiffness or weight that bent the piece, seven-twentieths of an inch.	Comparative strength or weight that broke the piece.
			pounds.	pounds.
Quercus robur.	·807	50·47	167	322
Quercus sessiliflora	·879	54·97	149	350

Both these specimens broke short without splitting, therefore these experiments offer a very fair view of the properties of the two species. The sessiliflora bent considerably more at the time of fracture than the robur, but it could not be measured with that correctness which is necessary to render such data useful.

The following table contains the values of the cohesive force, and modulus of elasticity, calculated from the above experiments.

Species of oak.	Cohesive force of a square inch in pounds.	Weight of modulus of elasticity in pounds for a square inch.	Comparative toughness.
Quercus robur . .	11,592	1,648,958	81
Quercus sessiliflora .	12,600	1,471,256	108

These pieces were hastily, and therefore imperfectly, seasoned; but as they were treated exactly alike, this would not effect the comparison.

There is another species, called the Durmast oak, which is a native of France, and the south of England; its wood is not so strong, nor of so firm a texture, as the English oak, and it retains its foliage much later.

The Austrian oak, is a taller tree than the English oak, but the wood is whiter, softer, and less valuable.

Of the American species, the chesnut-leaved oak is a tall tree, remarkable for the beauty of its form; the wood is coarse grained, but is very serviceable, and is much used for wheel carriages.

The mountain red oak (*Quercus rubra*) is a native of Canada, and the country west of the Alleghany mountains; it is called the red oak, from the leaves changing to a red, or purple colour, before they fall off. It is a large and fine tree, of 90 or 100 feet in height, and of rapid growth; the wood is useful for many purposes, but it is light, spongy, and not very durable.

The white oak, (*Quercus alba*,) so called from the whiteness of its bark, is a native of the woods from New England to Carolina, and acquires an immense size, in some of the middle states. Its wood is tough and pliable, and it is preferred to all others, in America, for both house and ship carpentry, being much more durable. It is less durable than British oak, but it is of a quicker growth.

The blunt-lobed, iron oak, is another of the American species, that produces very valuable ship-timber; the wood is hard, and not liable to decay, and is preferred for fencing. It is found in most of the upland forests, from Canada to Florida, and is a tree of 60 or 70 feet in height.

The species of the Riga oak, so valuable on account of the straightness of its grain, and freedom from knots, does not appear to have been determined: neither have I been able to find from what species the Dutch wainscot is obtained; it is grown in the forests of Germany, and floated down the Rhine.

According to Hassenfratz, the mean size of the trunk of the

Common oak is	45 feet in length, and	32 inches diameter.
White American oak	58	35
Red American oak	48	32

Oak, of a good quality, is more durable than any other wood that attains a like size. Vitruvius says, it is of eternal duration, when driven into the earth; it is well known to be extremely durable in water; and in a dry state, it has been known to last nearly 1000 years. The more compact it is, and the smaller the pores are, the longer it

will last; but the open, porous, and foxy-coloured oak, which grows in Lincolnshire and some other places, is not near so durable. Mr. Chapman very justly observes, that the heart, of such oak, is scarcely superior to the sap, of better kinds.

The chief use of oak is for ship-timber; the consumption of oak, for the construction and repair of the British navy, in 1788, exceeded 50,000 loads of timber. It is also useful for most of the purposes of the carpenter, and particularly in situations where it is exposed to the weather. It makes the best wall-plates, ties, templets, king-posts, and indeed it is best suited for every purpose, where its warping in drying, and its flexibility, do not render it objectionable; but, as Vitruvius has observed, it is very subject to twist, and occasion cracks in the work it is employed in.

The colour of the oak is a fine brown, and is familiar to every one; it is of different shades; that inclined to red is the most inferior kind of wood. The larger transverse septa are, in general, very distinct, producing beautiful flowers, when cut obliquely. Where the septa are small, and not very distinct, the wood is much the strongest. The texture is alternately compact and porous; the compact part of the annual ring being of the darkest colour, and in irregular dots, surrounded by open pores, producing beautiful dark veins, in some kinds, particularly in pollard oaks.

It has a peculiar smell, and the taste is slightly astringent. It contains gallic acid, and is blackened by contact with iron, when it is damp.

The young wood of English oak, is very tough, often cross grained, and difficult to work. Foreign wood, and that of old trees, is more brittle and workable.

Oak, warps and twists much in drying, and shrinks about one-thirty-second part of its width, in seasoning, according to Mr. Couch's experiments.

The cohesive force of oak, varies from 7,850 to 17,892 pounds per square inch. The mean of Mr. Barlow's experiments is 10,000 pounds. I have taken 11,880 as a standard to compare with the other woods, being the result of an experiment on a specimen of a mean quality.

The weight of the modulus of elasticity, for a square inch, is 1,714,500 pounds, from a mean of various specimens.

The weight of a cubit foot of different kinds, is as under:

English oak, from - - -	45 to 58 pounds, seasoned.
Riga oak - - - - - - -	43 to 54
Red American oak - - -	37 to 47
White American oak - -	50 to 56
Adriatic oak - - - - - -	58 to 68

Representing the strength, stiffness, and toughness of the common English oak (*quercus robur*) each by 100, it may be compared with the other kinds, as under:

	Common English oak.	Riga oak.	American oak.	Dantzic oak.
Strength . . .	100	108	86	107
Stiffness . . .	100	93	114	117
Toughness . .	100	125	64	99

It is necessary to observe, that the specimens of Riga and Dantzic oak, were of the best quality.

Division II.—In the second division, there are several species; I have described only four; the bleech, alder, plane, and sycamore. The woods of this division, are very uniform in their texture, and very durable in water; they are useful for piles and planking in wet situations, but not applicable to other kinds of carpenters' work. Woods of this division, do not warp so much as those of the first division.

1. Beech.—Of the beech tree, the *Fagus sylvatica* of botanists, there is one species, the common beech; the difference in the wood, proceeding, according to Miller, from the difference of soil and situation; but owing to this difference, the wood is distinguished by the names brown or black, and white beech.

Beech is durable when constantly immersed in water, but damp soon destroys it. In a dry state, it is more durable; but is soon injured by worms, whether it be in a damp, or in a dry state. Duhamel observes, that water-seasoned beech is much less subject to worms, than that seasoned in the common way; and Ellis says, to preserve it from worms, it ought to be cut about a fortnight after midsummer, and planked immediately; then the planks should be put in water about ten days, and afterwards dried.

Beech is not useful in building, because it rots so soon, in damp places, but it is useful for piles, in situations where it will be constantly wet; and it is very useful for various tools, for which its uniform texture and hardness, render it superior to any other wood: it is also much used for furniture, and great quantities are brought to London in boards and planks. Before cast iron was introduced, much beech was used for railways for the collieries about Newcastle.

The colour of beech is a whitish brown, of different shades; the darker kind, is called brown, and sometimes black beech; the lighter kind, is called white beech. The texture is very uniform; the larger septa are finer, and do not extend so far in the length of the wood, as in oak, therefore the flowers are smaller. The annual rings are rendered visible by being a little darker on one side, than on the other. It is very uniformly porous, and might be easily made to imbibe some ingredient that would prevent the worms destroying it.

It has no sensible taste or smell, it is not very difficult to work, and may be brought to a very smooth surface.

The white kind is the hardest, but the black, is tougher; and Evelyn says it is more durable, than the white.

The cohesive force of a square inch of beech, varies from 6070 to 17,000 pounds; the weight of its modulus of elasticity, is about 1,316,000 pounds; the weight of a cubit foot, dry, varies from 43 to 53 pounds. The higher numbers are from Muschenbroek, both in cohesive force and weight, and they are certainly much above any I have observed, as well as much above those of any other writer: about 12,000 pounds is its mean cohesive force.

Representing the strength of oak by	100, that of beech will be	103
stiffness of oak by	100, - - - - - - -	77
toughness of oak by	100, - - - - - - -	138

Hence it appears that oak is superior in stiffness, but neither so strong, nor so tough.

2. Alder.—The alder tree is the *Betula alnus* of botanists, a native of Europe and Asia, that grows in wet grounds, and by the banks of rivers. The tree seldom exceeds 40 feet in height.

The wood is extremely durable in water, or wet ground. Vitruvius has remarked, that in a wet state it will sustain the weight of very heavy piles of building, without risk of accident; and that the whole of the buildings at Ravenna, which is situate in a marsh, were founded upon piles of this wood. Evelyn says, he finds they used it under that famous bridge at Venice, the Rialto, which was built in 1591, or 228 years ago. But it soon rots when exposed to the weather, or to damp; and in a dry state, it is much subject to worms.

3. Plane Tree.—Of the plane tree there are several species. The most common, are the oriental plane, and the occidental plane.

The oriental plane (*Platanus orientalis*) is a native of the Levant, and other eastern countries, and is considered one of the finest of trees. It attains about 60 feet in height, and has been known to exceed eight feet in diameter. Its wood is much like beech, but more figured, and is used for furniture, and things of a like nature. The Persians employ it for their furniture, doors, and windows.

The occidental plane (*Platanus occidentalis*) is a native of North America, and is, perhaps, one of the largest of the American trees; on the fertile banks of the Ohio and Mississippi, some of the trees exceed twelve feet in diameter. It is, sometimes, called water-beech, and sycamore; but the wood called sycamore, in this country, is a species of maple. The wood of the occidental plane, is harder than that of the oriental kind; but the occidental, is the most common in Britain, and to it only, the rest of this article applies.

The colour of the wood of the plane tree, is nearly the same as that of beech, and it also closely resembles it in structure; but it differs in the larger septa; as in the plane, the septa are more numerous, producing very beautiful flowers, when properly cut. It works easily, and stands very well.

The cohesive force of a square inch, is about 11,000 pounds; its modulus of elasticity, is 1,343,000 pounds per square inch; and it weighs from 40 to 46 pounds, per cubic foot, when dry.

Representing the strength of oak by	100, that of plane tree will be	92
stiffness of oak by	100, - - - - - - - -	78
toughness of oak by	100, - - - - - - - -	108

The wood of the occidental plane, is very durable in water; and on that account, the Americans use it for wooden quays, in preference to any other kind.

4. Sycamore.—The sycamore, or great maple, (*Acer pseudo-platanus*) generally called the plane tree, in the north of England, is a native of the mountains of Germany, and is very common in Britain.

It is a large tree, and of quick growth; it thrives well, near the sea. According to Hassenfratz, the mean size of its trunk, is about 32 feet in length, and 29 inches in diameter. Evelyn says, that in

Germany, they have a better variety, than the one which grows in Britain.

The wood is durable in a dry state, when it can be protected from worms, but it is equally as subject to be destroyed by them, as beech. It is used chiefly for furniture, and the white wood of this tree, is valuable for many ornamental articles.

A century of the Names and Scantlings of Inventions. By the Marquis of Worcester.

(Continued from page 323.)

51. A rule of gradation, which, with ease and method, reduceeth all things to a private correspondence, most useful for secret intelligence.

52. How to signify words, and a perfect discourse, by jangling of bells of any parish church, or by any musical instrument within hearing, in a seeming way of tuning it, or of an unskilful beginner.

53. A way how to make hollow, and cover a water-screw, as big and as long as one pleaseth, in an easy and cheap way.

54. How to make a water-screw tight, and yet transparent and free from breaking, but so clear that one may palpably see the water, or any heavy thing, how and why it is mounted by turning.

55. A double water-screw, the innermost to mount the water, and the outermost for it to descend more in number of threads, and, consequently, in quantity of water, though much shorter than the innermost screw, by which the water ascendeth—a most extraordinary help for the turning of the screw to make the water rise.

56. To provide and make, that all the weights of the descending side of a wheel, shall be perpetually further from the centre, than those of the mounting side, and yet equal in number and heft to* the one side as the other. A most incredible thing, if not seen, but tried before the late king (of blessed memory†) in the tower, by my directions, two extraordinary embassadors accompanying his majesty and the Duke of Richmond and Duke Hamilton, with most of the court attending him. The wheel was 14 foot over, and 40 weights of 50 pounds a-piece. Sir William Balfore,‡ then Lieutenant of the Tower, can justify it, with several others. They all saw, that no sooner these great weights passed the diameter line of the lower‖ side, but they hung a foot further from the centre; nor no sooner passed the diameter line of the upper side, but they hung a foot nearer. Be pleased to§ judge the consequence.

57. An ebbing and flowing water-work, in two vessels, into either of which, the water standing at a level, if a globe be cast in, instead of rising, it presently ebbeth, and so remaineth until a like globe be cast into the other vessel, which the water is no sooner sensible of, but that¶ vessel presently ebbeth, and the other floweth, and so con-

* "Of."
† "Of happy and glorious," &c.
‡ "Sir W. Belford."
‖ "Upper."
§ "Lower."
¶ "The."

tinueth ebbing and flowing, until one or both of the globes be taken out, working some little effect besides its own motion, without the help of any man within sight or hearing: but if either of the globes be taken out, with ever so swift or easy a motion, at the very instant the ebbing and flowing ceaseth; for if, during the ebbing, you take out the globe, the water of that vessel presently returneth to flow, and never ebbeth after, until the globe be returned into it, and then the motion beginneth as before.

58. How to make a pistol to discharge a dozen times with one loading, and without so much as once new priming requisite, or to change it, out of one hand into the other, or stop one's horse.

59. Another way, as fast and effectual, but more proper for carabines.

60. A way, with a flask appropriated unto it, which will furnish either pistol or carabine with a dozen charges in three minutes' time, to do the whole execution of a dozen shots, as soon as one pleaseth, proportionably.

61. A third way, and particular for musquets, without taking them from their rests to charge or prime, to a like execution, and as fast as the flask, the musquet containing but one charge at a time.

62. A way for a harquebuss, a crock, or ship musquet, six upon a carriage, shooting with such expedition, as, without danger, one may charge, level, and discharge them, sixty times in a minute of an hour, two or three together.

63. A sixth way, most excellent for sakers, differing from the other, yet as swift.

64. A seventh, tried and approved before the late king (of ever blessed memory,) and a hundred Lords and Commons, in a cannon of eight inches half quarter, to shoot bullets of 64 pounds weight, and 24 pounds of powder, twenty times in six minutes; so clear from danger, that, after all were discharged, a pound of butter did not melt, being laid upon the cannon britch, nor the green oil discoloured that was first anointed and used between the barrel thereof; and the engine having never in it, nor within six foot of it, but one charge at a time.

65. A way that one man, in the cabin, may govern the whole side of ship musquets, to the number (if need require) of 2 or 3000 shots.

66. A way that, against several avenues to a fort or castle, one man may charge 50 cannons playing, and stopping when he pleaseth, though out of sight of the cannon.

67. A rare way, likewise, for musquetoons fastened to the pummel of the saddle, so that a common trooper cannot miss to charge them with twenty or thirty bullets at a time, even in full career.

When I first gave my thoughts to make guns shoot often, I thought there had been but one only exquisite way inventible, yet by several trials, and much charge, I have perfectly tried all these.

68. An admirable and most forcible way to drive up water by fire, not by drawing or sucking it upwards, for that must be, as the philosopher calleth it, *infra sphæram activitatis*, which is but at such a distance. But this way hath no bounder, if the vessels be strong

enough; for I have taken a piece of a whole cannon, whereof the *end* was burst, and filled it three-quarters full of water,* stopping and screwing up the broken end, as also the touch-hole, and making a constant fire under it, within 24 hours it burst, and made a great crack: so that having a way† to make my vessels, so that they are strengthened by the force within them, and the one to fill after the other, I have seen the water run like a constant fountain-stream, 40 foot high; one vessel of water, rarified by fire, driveth up 40 of cold water. And a man that tends the work is but to turn two cocks, that one vessel of water being consumed, another begins to force and refill with cold water, and so successively, the fire being tended and kept constant, which the selfsame person may likewise abundantly perform in the interim between the necessity of turning the said cocks.

69. A way how a little triangle screwed key, not weighing a shilling, shall be capable‡ and strong enough to bolt and unbolt, round about a great chest, an hundred bolts, through 50 staples, two in each, with a direct contrary motion, and as many more from both sides and ends; and, at the selfsame time, shall fasten it to the place, beyond a man's natural strength to take it away; and, in one and the same turn, both locketh and openeth it.

70. A key, with a rose-turning pipe, and two roses, pierced through endwise the bit thereof,‖ with several handsomely contrived wards, which may likewise do the same effects.

71. A key, perfectly square, with a screw turning within *it*, and more conceited than any of the rest, and no heavier than the triangle-screwed key, and doth the same effects.

72. An escutcheon to be placed before any of these locks, with these properties:—

1st. The owner (though a woman) may, with her delicate hand, vary the ways of coming to open the lock ten millions of times, beyond the knowledge of the smith that made it, or of me who invented it.

2nd. If a stranger open it, it setteth an alarm a-going, which the stranger cannot stop from running out; and, besides, though none should be within hearing, yet it catcheth his hand, as a trap doth a fox; and though far from maiming him, yet it leaveth such a mark behind it, as will discover him if suspected; the escutcheon, or lock, plainly showing what monies he hath taken out of the box to a farthing, and how many times opened since the owner had been at it.

73. A transmittable gallery over any ditch or breach in a town wall, with a blind and parapet cannon proof.

74. A door, whereof the turning of the key, with the help and motion of the handle, makes the hinges to be of either side, and to open either inward or outward, as one is to enter or to go out, or to open in half.

75. How a tape or riband-weaver may set down a whole discourse,

* "Full"—merely.

† "Found a way."

‡ "Triangle *and* screwed key shall be capable."

‖ "Together."

without knowing a letter, or interweaving any thing, suspicious of other secret than a new-fashioned riband.

76. How to write in the dark, as straight as by day, or candle-light.

77. How to make a man to fly, which I have tried with a little boy of ten years old in a barn, from one end to the other, on an hay-mow.

78. A watch to go constantly, and yet needs no other winding from the first setting on the cord or chain, unless it be broken; requiring no other care from one man, than to be now and then consulted with, concerning the hour of the day or night; and if it be laid by, a week together, it will not err much, but the oftener looked upon, the more exact it sheweth the time of the day or night.

79. A way to lock all the boxes of a cabinet (though never so many) at one time, which were by particular keys, appropriated to each lock, opened severally and independent the one of the other, as much as concerneth the opening of them, and by these means cannot be left open unawares.

80. How to make a pistol barrel, no thicker than a shilling, and yet able to endure a musquet proof of powder and bullet.

81. A comb-conveyance carrying of letters, without suspicion, the head being opened with a needle-screw drawing a spring towards them,* the comb being made but after an usual form carried in one's pocket.

82. A knife, spoon, or fork, in an usual portable case, may have the like conveyances in their handles.

83. A rasping-mill, for hartshorn, whereby a child may do the work of half-a-dozen men, commonly taken up with that work.

84. An instrument, whereby persons ignorant of arithmetic, may perfectly observe numerations and subtractions of all sums and fractions.

85. A little ball, made in the shape of a plum or pear, being† dexterously conveyed or forced into a body's mouth, shall presently shoot forth such, and so many bolts, of each side, and at both ends, as, without the owner's key, can neither be opened or filed off, being made of tempered steel, and as effectually locked, as an iron chest.

86. A chair, made *à-la-mode*, and yet a stranger being persuaded to sit down in't, shall have, immediately, his arms and thighs locked up beyond his own power to loosen them.

87. A brass mould, to cast candles, in which a man may make 500 dozen in a day, and add an ingredient to the tallow, which will make it cheaper, and yet so that the candles shall look whiter and last longer.

88. ‡How to make a brazen or stone head, in the midst of a great field, or garden, so artificial and natural, that though a man speak never so softly, and even whisper into the ear thereof, it will presently open its mouth, and resolve the question in French, Latin, Welch, Irish, or English, in good terms uttering out of his mouth, and then shut it until the next question be asked.

* "One." † "Which being."

‡ "An engine without the least noise, knock, or use of fire, to coin and stamp 100 lb. in an hour by one man."

89. White silk, knotted in the fingers of a pair of white gloves, and so contrived, without suspicion, that playing at primero, at cards, one may, without clogging his memory, keep reckoning of all sixes, sevens, and aces, which he hath discarded.*

90. A most dexterous dicing-box, with holes transparent, after the usual fashion, with a device so dexterous, that, with a knock of it against the table, the four good dice are fastened, and it looseneth four false dice, made fit for the purpose.

91. An artificial horse, with saddle and caparisons fit for running at the ring, on which a man being mounted, with his lance in his hand, he can at pleasure make him start, and swiftly to run his career, using the decent posture, with *bon grace*, may take the ring as handsomely, and running as swiftly, as if he rode upon a barb.

92. A screw, made like a water-screw, but the bottom made of iron plate, spade wise, which, at the side of a boat, emptieth the mud of a pond, or raiseth gravel.

93. An engine, whereby one man may take out of the water, a ship of 500 tons, so that it may be calked, trimmed, and repaired, without need of the usual way of stocks, and as easily let it down again.

94. A little engine, portable in one's pocket, which, placed to any door, without any noise, but one crack, openeth any door, or gate.

95. A double cross-bow, neat, handsome, and strong, to shoot two arrows, either together, or one after the other, so immediately, that a deer cannot run two steps, but, if he miss of one arrow, he may be reached with the other, whether the deer run forward, sideward, or start backward.

96. A way to make a sea-bank, so firm and geometrically strong, that a stream can have no power over it; excellent, likewise, to save the pillar of a bridge, being far cheaper and stronger, than stone walls.

97. An instrument whereby an ignorant person may take any thing in perspective, as justly, and more, than the skilfullest painter can do, by his eye.

98. An engine, so contrived, that working the *primum mobile* forward or backward, upward or downward, circularly or cornerwise, to and fro, straight, upright, or downright, yet the pretended operation continueth, and advanceth none of the motions above-mentioned, hindering, much less stopping, the other; but unanimously, and with harmony, agreeing, they all augment and contribute strength unto the intended work, and operation; and, therefore, I call this *a semi-omnipotent engine*, and do intend that a model thereof, be buried with me.

99. How to make one pound weight, to raise an hundred, as high as one pound falleth, and yet the hundred pound descending, doth what nothing less than one hundred pound can effect.

100. Upon so potent a help as these two last-mentioned inventions, a water-work is, by many years experience and labour, so advantageously, by me, contrived, that a child's force bringeth up, an hundred foot high, an incredible quantity of water, even two foot diameter, *so naturally, that the work will not be heard, even into the next*

* "Without foul play."

*room; and with so great ease and geometrical symmetry, that though it work day and night, from one end of the year to the other, it will not require forty shillings reparation to the whole engine, nor hinder one's day work;** and I may boldly call it the most stupendous work in the whole world: not only, with little charge, to drain all sorts of mines, and furnish cities with water, though never so high seated, as well to keep them sweet, running through several streets, and so performing the work of scavengers, as well as furnishing the inhabitants with sufficient water for their private occasions; but likewise supplying rivers, with sufficient to maintain, and make them portable, from town to town, and for the bettering of lands all the way it runs; with many more advantageous, and yet greater effects of profit, admiration and consequence. So that, deservedly, I deem this invention to crown my labours, to reward my expenses, and make my thoughts acquiesce in way of further inventions; this making up the whole century, and preventing any further trouble to the reader for the present, meaning to leave to posterity a book, wherein, under each of these heads, the means to put in execution, and visible trial, all, and every of these inventions, with the shape and form of all things belonging to them, shall be printed by brass plates.

In bonum publicum, et ad majorem Dei gloriam.†

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* The words marked in italics, not in the MS.

† "Besides many omitted, and some of three sorts willingly not set down, as not fit to be divulged, least ill use may be made thereof; but to shew that such things are also within my knowledge, I will here in mine own cypher set down one of each, not to be concealed when duty and affection obligeth me."

‡ "A *mute* yet perfect discourse, as far distant as eye can reach by day to discern colours."

‖ "Though never so dark."

§ "Multiplying."

¶ "Flowing clock."

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The Steam Engine actually constructed and applied to Practical Purposes, by the Marquis of Worcester.

Mr. Stuart, the author of the Historical and Descriptive History of the Steam Engine, has just published the first part of another work, entitled, "Anecdotes of Steam Engines," which contains, among other novel and interesting matter, the following unexpected evidence, that the Marquis of Worcester did not merely imagine the probability of employing steam, as a moving power, but that he actu-

* *And each of these*—wanting.
† Forsacres.
‡ "For whole cannon."
‖ *A whole side of*—wanting.
§ *Or riband*—wanting.
¶ "A continual watch."
** *A total*—wanting.
†† "81, 82. Conveyance for letters."
‡‡ Wanting entirely in the MS.
‖‖ "Stamping engine."
§§ "Primero gloves." The Marquis seems to have been in doubt which he should erase—the brazen head, or the dicing-box.
¶¶ Wanting in the MS.

ally constructed an engine, on this principle, and applied it, successfully, to the raising of water. It may be recollected, that in his former work, Mr. Stuart, differing from most other writers who have touched on the merits of the Marquis of Worcester, inclined to the opinion, that, nearly all the "inventions," and this of the steam engine in particular, for which the Marquis took credit, and which have made his name so celebrated, existed in fancy only. Subsequent investigation, however, has convinced Mr. S. that he did great injustice to the memory of the Marquis, in this respect; nor can any one, we think, who reads the following extract, have a doubt that, as regards steam power, at least, he has all the merit of being, both the first to conceive the important uses in the arts and manufactures, to which it might be applied, and the first to avail himself, in practice, of the giant strength, which it has superadded to human industry and skill. [*Editor Lond. Mech. Mag.*

"The fact of the Marquis ever having given to the water-commanding engine, any, except a *descriptive existence*, is debatable ground, with authors in mechanics; and, on that account, it may be considered to require some higher authority than mere inference, to decide the point of his having actually constructed an engine.

"The references, it is admitted, are all drawn from the marquis' *own* account of his *own* invention, and which were addressed to the public, in order to induce them to listen to his schemes, and to patronise them. As his pretensions were as high, as his imagination was prolific and sanguine, some shade of suspicion may attach to them as being highly coloured, from a less unworthy motive than deception—the gratification of personal vanity. Yet, surely, even this will not be urged, when he is followed into his closet. In his address to the Deity, the phantoms of an overweening conceit could find no place; after his death, the following manuscript prayer was found among his lordship's papers:—

"'The Lord Marquis of Worcester's ejaculatory and extemporary thanksgiving prayer, when first with his *corporal eyes he did see* finished, a perfect trial of his water-commanding engine, delightful and useful, to whomsoever hath, in recommendation, either knowledge, profit, or pleasure.

"'Oh! infinitely omnipotent God, whose mercies are fathomless, and whose knowledge is immense and inexhaustible, next to my creation and redemption, I render thee most humble thanks, from the very bottom of my heart and bowels, for thy vouchsafing me (the meanest in understanding) an insight in so great a secret of nature, beneficial to all mankind, as this my water-commanding engine. Suffer me not to be puffed up, O Lord, by the knowing of it, and many more rare and unheard of, yea, unparalleled inventions, trials, and experiments; but humble my haughty heart, by the true knowledge of mine own ignorant, weak, and unworthy nature, prone to all evil. O, most merciful Father, my creator, most compassionating Son, my redeemer, and holiest of Spirits, the sanctifier, three divine persons and one God, grant me a further concurring grace, with fortitude to take hold of thy goodness, to the end, that whatever I do, unanimously, and

courageously to serve my king and country, to disabuse, rectify, and convert my undeserved, yet wilfully incredulous enemies, to reimburse, thankfully, my creditors, to reimmunerate my benefactors, to reinhearten my distressed family, and with complacence to gratify my suffering and confiding friends, may, void of vanity and self-ends, be only directed to thy honour and glory everlasting.'

"Although, at every period of his life, he seems to have been deeply impressed with the feeling, that progress never was made in any thing by supine wishes, and dilatory efforts, yet unremitting perseverance and assiduous industry, were, in his case, to be of no avail, in stemming the tide of adverse fortune; his wishes were written in sand; and in the prosecution of his philanthropic projects, he was fated to experience, not only the neglect of the public, but the ingratitude of friends, without being convinced of the hopelessness of the attempt at introducing improvements beyond the comprehension, and spirit of the age. As long as hope survived, and that ceased not until he 'was summoned by the angel of death,' he continued to prefer, with vigour, his claims to public attention, and patronage.

After his death,* the marchioness, who seems to have been of a congenial spirit, and to have been actuated by no small share of her husband's enthusiasm, continued her exertions to introduce the water-commanding engine. The zeal with which she prosecuted her scheme, being considered unbecoming her sex, and derogatory to her quality, a Romish priest, who had some influence with her ladyship, was selected, to expostulate, on the impropriety of her conduct, and to convey to her, the wishes, and opinions, of her friends. 'All those,' says the confessor, with no small boldness, 'who wish you well, are grieved, to see your ladyship to be already so much disturbed, and weakened in your judgment, and in danger, to lose the right use of your reason, if you do not timely endeavour to prevent it, by ceasing to go on with such high designs as your are upon; which I declare, on the faith of a priest, to be true. The cause of your present distemper, and of the aforesaid danger, is doubtless, that your thoughts and imaginations, are very much fixed on your title of Plantagenet, and of disposing of yourself for that great dignity, by getting of great sums of money from the king, to pay your deceased lord's debts, and enriching yourself *by the great machine, and the like.* Now, madam, how improper such undertakings are for your ladyship, and how impossible for you to effect them, or any of them, all your friends can tell you, if they please, to discover the truth to you.'

"'The effects,' continues the confessor, 'that flow from hence, are many; as the danger of losing your health, and judgment, by such violent application of your fancies, in such high designs, and

* The marquis died at London, on the 4th of April, 1667, and his remains were carried in much state to Ragland Church, and interred in the family cemetery. Heath examined the vault in 1795, and found there, a plate which had been placed on the coffin, with the following inscription:—

Illustrissime Principis Edwardi Marchionis et Comitis Wigorniæ Comitis de Glamorgan, Baronis Herbert de Ragland, et qui obit apud Londini tertio die Aprilis A Dni. MDCLXVII.

ambitious desires; the probability of offending the Almighty God, and prejudicing your own soul, thereby; the advantage you may thereby give to those who desire to make a prey of your fortune, and to raise themselves by ruining of you. I confess, that the devil, to make his suggestions the more prevalent, doth make use of some motives that seem plausible; as of paying your lord's debts, of founding monasteries, and the like; and that your ladyship hath the king's favour to carry on these designs.'*

"*The great machine*, appears at this time, to have been in existence; but it were idle to multiply instances, from the Marquis' personal history, or from that of his family. The first, has been thought to savour of enthusiasm, and the latter, might be ascribed, however unjustly, to the praiseworthy, but probably mistaken, gratitude of those, whose affection might urge it as a duty, to be tender of the reputation of an amiable relation, or friend, even in matters, which might be considered as those of his wanderings.

"No such objection can, however, apply to the testimony of an eye-witness, and one who cannot be accused, as speaking from either interest, or friendship. The inspection was made, two years after the death of the noble inventor; the account of it, written in a foreign tongue, lay hidden in a manuscript, deposited in a foreign library, for one hundred and fifty years after the machine itself, probably, ceased to be in existence; and we feel no small gratification, in being the first to give it a place in the history of the steam-engine.

"About the year 1656, Cosmo de Medicis, grand duke of Tuscany, sought respite, and solace, from unhappy family dissentions, by visiting the courts of foreign countries. Cosmo was accompanied by a retinue of men of letters, and artists, for the purpose of recording those circumstances and scenes, which, during his journey, might appear worthy of remembrance. A minute, and circumstantial account of each day's occurrences, was regularly entered into a journal, by the grand duke's secretary. At Cosmo's return to Italy, this Diary was carefully deposited, in the ducal library at Florence.

"From its containing a variety of particulars, respecting persons and places in England, it had become an object of considerable interest to those Englishmen, who were aware of its existence. But it was not, until 1818, that any part of its contents, was disseminated by the press, when that portion of the manuscript volume, which related to England, was translated from the Italian, and published in a quarto volume.

"In that translation, under the date of the 28th of May, 1699, we have the following account of *one* of Lord Worcester's machines:— 'His Highness, that he might not lose the day uselessly, went again, after dinner, to the other side of the city, extending his excursion, as far as Vauxhall, beyond the palace of the archbishop of Canterbury, to see an hydraulic machine, invented by my Lord Somerset, Marquis of Worcester. It raises water more than *forty geometrical feet*, by the power of *one man only;* and in a very short space

* The Marchioness died in 1681.

of time, *will draw up four vessels of water, through a tube, or channel, not more than a span in width*; on which account, it is considered to be of greater service to the public, than the *other* machine near Somerset-house.'

"This, therefore, is superior in its operation, to *another machine, by a different mechanic, and applied to the same purpose.*

"Now, in another part of the same Diary, it is stated, that 'his Highness went to see an hydraulic machine, raised upon a wooden tower, in the neighbourhood of Somerset-house, which is used for conveying the water of the river, to the greatest part of the city. It is put in motion by *two* horses, which are continually going round; it not being possible that it should receive its movement from the current of the river, as in many other places, where the rivers never vary in their course: but this is not the case with the Thames, owing to the tide; consequently, the wheels which serve at the ebb, would not do their duty, when the tide returns.'

"Nothing can be more satisfactory, than this last notice; the water in the hydraulic machine at Vauxhall, by the most easy inference, was *not* elevated by a water-wheel, otherwise the grand duke would not have omitted to mention so striking a deviation from that at Somerset-house. The effect was equal to that of another, worked by *two horses;* and a tyro in mechanics would, at first sight, say, that no combination of machinery, could accomplish that work by one man, which it required the power of twelve men, to do in another. From all the circumstances, therefore, it appears to us, clear, that this great effect was produced by some sort of a steam-engine; the very identical, 'most stupendous water-commanding engine;' the 'semi-omnipotent engine;' 'the admirable, and most forcible way, to drive up water by fire;' 'the most stupendous water-work, in the whole world,' which he humbly beseeched God to make him humble, as being its discoverer; and which, when he had gone to that 'bourne from whence no traveller returns,' his widow incurred the imputation of insanity, for persisting to carry forwards. And well may we add, in his own language, that in our times, it appears, indeed, 'to have been produced by heavenly inspiration,' and in its power, 'boundless in height, and quantity.'

"From the brevity of the notice in the grand duke's manuscript, it is probable he was ignorant of its principle. It was too novel to be forgotten, had it been imparted to his Highness. But this sort of concealment was the fashion of that time, as it is, in some instances, that of our own. Other coincidences, between the descriptions of Cosmo's journal, and those in the 'Century of Inventions,' are truly remarkable. In both, the height of *forty feet*, is stated to be the elevation to which the water is to be raised; in both, the attendance of *one man* is mentioned; and *four vessels* of water, through a tube, or channel, of not more than a span in width, being drawn up, is almost the same choice of words, used in his celebrated sixty-eighth proposition. In fact, had the marquis been describing the engine himself, from a view of it, in operation, without wishing to describe the principle of its operation, he could scarcely have used other terms, than those used in the journal of Cosmo of Medici."

On Preparing, and Bleaching, Flax and Tow. *By* THOS. GILL, ESQ.

WE find in the Philosophical Magazine and Annals of Philosophy, for last month, an article by the Rev. J. B. Emmett, on a method of bleaching, and *preparing* flax; now, as we have given in our work, a number of different articles on this interesting subject, we naturally had our attention excited by the title of the above article: on perusing it, however, so far from finding it to be what it professed, viz. a new method of bleaching, and *preparing* flax, it turned out to be merely *a bleaching, or whitening process*, effected by steeping, or boiling the flax, or tow, in a weak solution of sub-carbonate of soda or potash, in order to extract the colouring matter, resin, &c.; and, after washing the alkali out, finishing the whitening by the use of a little finely powdered charcoal, mixed in a large proportion of water, and with which the flax, or tow, was to be thoroughly incorporated, and suffered to remain steeping, for twenty, or twenty-four hours; and lastly, exposing it, with the charcoal intermingled with it, upon the grass, to the action of air, and light; after which, the remaining charcoal was to be washed out; not a word being said on the *far more important processes of water-rotting, braking*, and *hackling*, to which, it was most likely subjected, as usual, by way of *preparing* it for the bleaching, or whitening process, which is all that Mr. Emmett treats upon.

In the present *degraded state* of the linen manufacture, in Ireland, (which must eventually terminate in the ruin of its reputation for making a *durable fabric*, every means being, apparently, taken to insure *its quickly perishing in wear*,) we should gladly hail the adoption of any process which might tend to preserve the naturally strong fibres of flax; but, after the repeated failures of the endeavours to improve the linen manufacture, particularly in the instances of the late Mr. Lee, and of Mr. Salisbury, we must confess that our expectations of such an improvement taking place, are by no means sanguine.

In order, however, to put our readers into possession of the means of preserving the native strength, and beauty, of the vegetable fibres, we shall proceed to quote an article by Gavin Inglis, Esq., originally published in the Philosophical Magazine, in the year 1818, and again by us in our sixth volume, page 328, wherein he says, that he had, in his business of a bleacher, in Dumbartonshire, a few spindles of yarn given him, in the year 1801, to prepare for weaving. There was, in the *sleekness* of the thread, something that attracted his attention. Having soaked it, over night, in warm water, to prepare it for steaming, he was much surprised at the change of colour, and at the quantity of colouring matter dissolved in the water. It was then washed, wrung, and soaked in *weak alkaline ley*, and, laid for steaming, over some brown linens. After steaming the usual time, the covers were taken off, and the yarn was found to have attained a degree of whiteness he had never before observed, under similar circumstances. It was washed in a stream, as long as any colour came from it, and laid on the grass, for two days. That he remembered, well, *the colour*

was such as to impress him with a strong belief that some great and important discovery might be the result of following up the process this flax had previously gone through, before coming into his hands. He accordingly traced it, until he found that the flax had been purchased at a Kilmarnock fair, and that it had been pulled before it was *too ripe*, the *greenest pulled* being intended for the *finest purposes*; and that the *whitest flax*, after drying, *had been watered in the burn. They were very particular in watering, and did not allow it to remain so long in the water as he had been led to suppose, from the practice in Dumbartonshire;* nor did they spread it on the grass, after watering, as was likewise the mode in that district, but dried it all from the water, by what is termed *hutting*. He also found that *the white flax, had been uniformly watered in the burn*, and *the dark-coloured, in ponds*, dug where water could be most conveniently obtained; and that when he mentioned a *burn*, he meant *a stream*, so small as to require a dam, being necessary, to receive the water into a temporary pond, to cover the flax. That he conceived *the succession of clean water*, prevented the deposition of *colouring principles* upon the flax, by washing them away, after being extracted from the flax, which he afterwards had an opportunity of proving, *in a pond so constructed, which produced remarkably white flax;* while *the same flax, from several stagnant ponds*, dug in the same ground, filled with water from the same spring, *was very dark in colour.*

The occasion of our republishing this article, arose from our having given, in the preceding number of our work, Vol. VI., page 281, an account of a new method of watering hemp and flax, introduced into Holland by M. Hondt d'Arcy, and which consisted in exposing them, after drying and separating their leaves from them, to the action of a fall of water, of from four to six feet in height, the bundles of hemp or flax being spread over the lower of two wooden gratings, and confined between the other grating, placed upon them. The water was changed every hour, falling through the hemp or flax at each change; during the twenty-four hours; and the process was continued until it was no longer coloured, and which generally required ten or twelve days. The quantity of water applied, and its current, required care, for, if it ran too violently, the substances placed within the gratings might be carried away by it. The regular renewal of the stream of water, produced a uniform colour, and also distributed and preserved, throughout the mass, a proper degree of heat, and it also promoted an equally uniform watering. It was desirable that the sun should not be permitted to shine upon the apparatus.

The flax and hemp, treated by this latter process, *afforded a more flexible, and silky fibre*, than by the ordinary method. And a second advantage was, that a result was obtained in twelve days, which ordinarily required three or four weeks.

Mr. Inglis seems to have previously ascertained the same beneficial results as M. Hondt d'Arcy, from the practice employed in the neighbourhood of Kilmarnock, of *watering flax in a running stream;* and we may add, that the same practice seems to have been adopted in Somersetshire, in the sail-cloth manufacture, in the neighbour-

hood of Yeovil; *the flax being there watered in running streams*, and no doubt with great advantage, in respect to the strength and durability of the sail-cloth; and we may also add, from our own knowledge, to the paper afterwards made of such old sail-cloth.

Mr. Inglis goes on to state, that in *unripe flax*, *he found the colouring matter to be soluble in water;* but this matter, as the flax grew ripe, became less and less soluble, till the water made little or no impression upon it.

In *unripe flax*, the juices of the plant are in a *mucilaginous* state; hence its solubility in water. But if the flax is allowed to stand upon the ground, till it has attained a *rusty brown colour*, and the seed is fully ripened, the juices of the plant are then changed, from *mucilage* to *resinous matter*, and, so far as the *resin* is concerned, are certainly *no longer soluble in water*, unless assisted by solvents.

We added, in a note, that Mr. Lee, after treating flax by his patent machinery (the patent for which, is now nearly expired,) afterwards merely washed it in warm water, then in a weak soap-ley, and, lastly, exposed it to the light of the sun and air, for a very few hours, upon the grass; and that the specimens in our possession, so treated by him, *are of the most beautiful whiteness*, and have a *silky lustre*, which has actually caused them to be mistaken, by the dealers in silk, for that article. To this we may now add, that Mr. Lee first *braked* the stems of flax, by his improved brake, until it was separated from its woody parts, and could be formed into an endless loop or sliver, by turning one end of the hand of flax, within the other end, having previously passed that end, between a pair of grooved or channelled iron rollers, pressed together by weighted levers, which were driven by machinery, and resembled two long pinions, actuating each other; between the teeth of these rollers, the loop or sliver of flax was kept continually revolving; the *cross fibres* of it, which naturally hold *the longitudinal fibres together*, being broken by the attrition of the rollers, and falling away under them in the form of a delicate, yellow powder. This process was continued a sufficient time, or until the longitudinal fibres appeared to be completely freed from the cross fibres; when they were, as above-mentioned, merely drawn a few times up and down, through warm water, to which they gave a yellowish tinge, and then through a weak soap-ley; they were next opened, and laid upon the grass to bleach, turning them once or twice, and finally finished, by again subjecting them to the action of the rollers, to give them *their beautiful silky whiteness.* We once selected a parcel of *the slenderest stems* from the bundles of flax at Merton Abbey, in Surrey, where Mr. Lee had last established his patent machinery, in the course of the morning of the day we were there, and saw them treated as we have described; and on the following day, they were sent to us perfectly bleached and hackled, and divided into the long flax, and the tow; and form, perhaps, the finest specimens of flax, ever prepared, in this, or any other country, both from the delicacy of the fibres, arising from the slender stems we selected, and from the exquisite *beauty*, *whiteness and silky glossiness* of the flax; and we shall ever regret the causes which afterwards led

to the abandonment of a concern, which promised to bring the linen manufacture of this country, to a pitch of unexampled excellence.

Our readers will, no doubt, have now arrived at the conclusion, that the Rev. Mr. Emmett has confined his improvements, to the mere *whitening*, and *finishing*, of the flax and tow; and that the previous operations of *steeping*, *braking*, and *hackling*, must all have been applied, before his operations could take place. We know not how flax may be treated in Yorkshire, but if *watered in running streams*, no doubt his whitening process may answer, as it did in the hands of Mr. Inglis, who had adopted that part of his practice, of *soaking the flax in weak alkaline ley*, in the year 1801. With regard to the application of *powdered charcoal*, Mr. Inglis found no difficulty in finishing the whitening of his flax by the ordinary practice of steaming; and Mr. Lee, after treating the flax, by his machinery, merely washed it in warm water, then in a weak soap ley, and laid it upon the grass to bleach and whiten. We well know the powers of charcoal, particularly *animal charcoal*, in bleaching vegetable matters; but, in case the flax had been steeped in *stagnant water*, as is the general *and most offensive practice*, and especially if it had been also covered with the *black mud* lying at the bottoms of the ponds, as is the present practice in Ireland, and whereby the *flax becomes dyed*, we very much question whether any thing, short of the *powerful chemical means* actually employed in Ireland, *and by which the quality of the flax so greatly suffers*, could remove that *dye*.

[*Technical Repository*.

On Neutralizing the Magnetism of Watches, and other Time Keepers. By MR. ABRAHAM, *of Sheffield.*

From the Transactions of the Society for the Encouragement of Arts, &c.

It is, I believe, generally understood by those who have not made the science of magnetism a study, that the fluid is *communicated* to steel bars, and other articles capable of possessing permanent active magnetism, by induction, friction with magnetic bars, &c. &c.

In my opinion, the very contrary is the fact. All ferruginous bodies possess the magnetic fluid, in a latent or inactive state, in proportion to their purity; this fluid may be brought into action, and concentrated, by various means; as position, friction, percussion, attraction, galvanism, electricity, &c. I believe that attraction is the most general cause, of the steel works in time pieces, becoming actively magnetical.

Valuable watches are frequently observed to keep very irregular time, from no visible cause, while the works remain in connexion; and also after they are separated, unless the steel works are tested, by plunging them into fine steel filings. From the minuteness and delicacy of those parts of a time-piece which are manufactured from steel, it has been considered, by those watch-makers with whom I

have conversed on the subject, to be almost an impossibility to deprive them of active magnetism, by any other means than that of heat.

When a balance, or verge, has been exposed to a sufficient heat to distribute the fluid, it becomes unfit for further use, till hardened, and polished; and even then, it is frequently spoiled; therefore, watchmakers prefer, either returning the watch in its magnetic state, or supplying new apparatus, which generally incurs an expense of six or seven shillings, in a common watch, and a greater sum in proportion to the value of the works. In attempting to *distribute* (or, according to the general term, *take out*) the magnetism, in any part of the steel works of a watch, with a *very fine magnet*, by *touching* it in a contrary direction, or with a different polarity, it must be complete chance, if the experiment succeeds; since the power applied, and the delicacy of the *touch*, must be in proportion to the activity of the magnetism, and the fineness of the part containing it; for, wherever the *finest* magnet last touches any part of a balance, it will leave a small concentration of magnetic power.

With a series of fine, and very delicate magnets, I always failed in *completely* neutralizing the fluid, by the touch. After spending much time without success, I was still determined to surmount the difficulty, if possible. Upon studying the first cause of all my trouble and disappointment, I was led to believe that I, very probably, might destroy the effect, by means similar to those which produced it; and in this I was not disappointed, for the experiment succeeded equal to my expectations. Time-pieces generally become actively magnetical, without being brought into contact with the agent that concentrates the fluid; but, according to the laws of magnetism, a polarity, contrary to that of the magnet presented to it, will always be found in the part rendered magnetical.

This proves that the fluid is put in motion, and concentrated, by *attraction;* present the contrary power in the agent (not in contact) to the same part of the machinery, and it will repel or re-distribute the fluid which was previously attracted, and if it be kept in that position, the least period of time beyond that which is necessary to neutralize the fluid, it will give contrary polarity, to the part subjected to the experiment.

For some time, I found a little difficulty in performing the experiment, satisfactorily, owing to the invisibility of the fluid; but I was relieved from this difficulty, by dipping the apparatus to be experimented upon, into fine steel filings, which rendered the situation of the active magnetism, visible.

Upon presenting a fine magnet to the part clothed with filings, at the distance of, from one inch, to one quarter of an inch, according to the power to be neutralized, it will immediately be perceived whether the polarity of the magnet be of the same kind as that in the apparatus: if so, the filings will gradually fall from the part, as the power becomes neutralized; when all the filings have fallen from the part submitted to experiment, dip it again into the filings, to prove whether it has acquired opposite polarity, by remaining too long in the vicinity of the magnet; if that be the case, present the contrary end of the

magnet at a distance proportionate to the power to be diffused. Very little practice will enable any person to deprive any part of the steel apparatus belonging to the time-piece, of active magnetism, in two or three minutes. I can generally perform the experiment in one minute, however magnetical the balance, or other part may be, that is to be deprived of this concentrated power.

On a new method of producing Landscapes, &c. by means of Black-lead dust. By Mr. GALPIN, *of Charmouth.*

Having, in common with, I believe, all admirers of drawing in black-lead pencil, long regretted, that a material of such a natural and pleasing neutral colour, should be confined to the tedious process of producing broad gradations of shade, by means of a laborious repetition of lines or touches, I commenced, about two years ago, a series of experiments, with a view of producing a breadth of touch, and an effect, equal to oil painting, supposing it to be executed in a neutral tint, corresponding with the colour of black-lead; but I found, after indefatigable labour, that the granular separation of that material, when applied to paper, rendered it impossible, although I remained satisfied that it would be superior to any other material for the general purposes of drawing, if this impediment could be removed; and about two months ago, considering that I had heretofore only applied the material in its natural state, I resumed the pursuit, by reducing it to an impalpable powder, and using it with a brush, palette, &c.; the result has been the most complete success; and by a process exceedingly easy and simple, by which, every possible degree of shade can be produced, with the nicest uniformity of tint, when necessary, and in less than a twentieth part of the time required in the ordinary manner; with an apparatus too which does not exceed the cost of one shilling, consisting of a small piece of fine muslin, filled with dark black-lead, reduced to fine powder, (and tied up similar to bladder colours used by artists,) which I have called a *shader;* a *palette*, made of thick card-board; and a *brush*, (such as is used by artists, in oil) of medium size.

Process.—The shader, is rubbed two or three times on the palette, near one extremity, by which a small portion of the lead is sifted, as it were, through the muslin; the brush is passed round in the pulverized lead, and on some other part of the palette, to adjust the shade required; the brush is then applied to the paper, with a circulating motion, to produce a sky, or other expanse of shade. A sky which, before this invention, has taken me six or eight hours, I now execute in as many minutes.

The sea, is produced by the pith of the common elder, the wood of which is cut away, so as to expose the pith to the touch, which, on being applied to the palette, and then to the paper, produces a beautifully soft, and gradual touch.

From the beautifully uniform tint, produced by the brush and pul-

verized lead; I was led to try the possibility of applying it to useful ornamental purposes, by means of the process of stencilling.

The figures or patterns, are cut out in thin card; one of these being laid on the paper, the brush, previously charged with black-lead, is passed over it with a circular motion, and an impression, or rather a copy of the figure, is the effect. Complicated ornaments, may be produced by the successive application of two, or more figures, on the same ground, or by moving the pattern a little, and then producing a second copy, which will mingle with, and modify, the first. Both these methods, even, might be combined, if a very complicated figure, difficult of imitation, was wanted.

I beg particularly to remark, that my principle of producing skies, can be adopted by any artist, without interfering with his general style of drawing, and is so exceedingly easy, that a novice cannot fail of producing a tolerable effect. I have received several applications from amateurs, (who have presumed I used Indian ink,) to ascertain how I produced my skies so rapidly, but I have not yet communicated my process to any individual, from the hope, that the Society of Arts, will consider my invention an acquisition to the arts, and give it a place in their volume of Transactions; and I beg leave, to add, that it would be highly gratifying to my feelings, to have it first made public, through so distinguished a source; and that I shall feel happy to give the Society any further information on the subject.

P. S. I think I omitted to mention, that the common black-lead, is ground in water, on a stone, in the manner of ordinary paint; then dried before the fire, or in an oven, and again reduced to powder, in a mortar; when it is tied up in muslin, as described in my first communication; in the space of ten minutes, a sufficient quantity may be prepared, to supply the constant application of three months.

The materials used by me, in executing drawings in black-lead, are three brushes, made of badger's hair, similar to those used by painters in oil-colours, and denominated softeners, except being only one-third of the length of ordinary softeners, in the hair; the largest brush, is one inch in diameter, the second, three-eighths, and the smallest, one-eighth of an inch, in diameter. A palette of ordinary size, made of thick card-paper. The pith of the common elder tree, dried naturally; and two small muslin bags, filled with pulverized black-lead.—*Ib.*

On making Elastic Moulds of Glue, for castings in Plaster of Paris. By Mr. Douglass Fox, *Surgeon.**

Having been much employed in taking casts of anatomical preparations, I frequently met with specimens, principally of hard substances, that did not admit of the moulds hitherto employed, being removed from them. This arose, from any given specimen of such

* From the Transactions of the Society for the encouragement of Arts, Manufactures, and Commerce.

description, having various portions of it with considerable overlaps; that is, there were hollows, or undercut parts, from which no mould could be withdrawn, without its being injured.

Although, in many instances, soft clay, or soft wax, may be used to take impressions, still these, in numberless instances, cannot be removed from the body to be moulded, without being injured, in those parts, which were pressed into the hollows; to overcome these difficulties, it appeared evident, that if an *elastic* substance could be substituted for the soft clay, or wax, the moulds might be withdrawn uninjured, by giving way during the removal, from the undercut parts of any such body, and also, that the moulds would afterwards return to their proper forms again. To effect this, I have made use of glue, which has answered perfectly, employed as follows:—

The body to be moulded, previously oiled, must be secured one inch above the surface of a board, and then surrounded by a wall of clay, about an inch distant from its sides, the clay must also extend rather higher than the contained body; into this, warm melted glue, as thick as possible, so that it will run, is to be poured, so as to completely cover the body to be moulded; the glue is to remain till cold, when it will have set into an *elastic* mass, just such as is required.

Having removed the clay, the glue is to be cut into as many pieces as may be necessary for its removal; either by a sharp pointed knife, or by having threads placed in the requisite situations, on the body to be moulded, which may be drawn away when the glue is set, so as to cut it in any way that may be desired; the use of these threads, need not be more fully explained, as the method is generally known, to persons in the habit of casting.

The portions of the glue mould, having been removed from the original, are to be placed together, and bound round by tape.

In some instances, it is well to run small wooden pegs through the portions of glue, so as to keep them exactly in their proper positions. If the mould is of considerable size, it is better to let it be bound with moderate tightness upon a board, to prevent it bending whilst in use; having done as above described, the plaster of Paris, as in common casting, is to be poured into the mould and left to set.

In many instances, wax may also be cast into glue, if it is not poured in whilst too hot, as the wax cools so rapidly, when applied to the cold glue, that the sharpness of the impression is not injured.

I have stated glue as succeeding well, where an *elastic* mould is alone applicable; but many modifications are admissible. When the moulds are not used soon after being made, treacle should be previously mixed with the glue, (as employed by printers,) to prevent it becoming hard.

The description thus given, is with reference to moulding those bodies, which cannot be so done by any other than an *elastic* mould; but glue moulds will be found greatly to facilitate casting, in many departments, as a mould may frequently be taken by this method in two or three pieces, which would, on any other principle, require many.

DOUGLASS FOX.

The specimens accompanying Mr. Fox's communication, were casts of a deer's horn, and of a calculous concretion, very rough and tubercular, on the surface. The committee, considered it desirable to have before them, also, a specimen of a cast from some soft anatomical preparation, and accordingly directed the secretary to make known their wish to the candidate. This was done, and produced the following additional communication, accompanied by a cast from a fœtus, as described in Mr. Fox's letter.

Derby, May 13, 1826.

In compliance with the request of the committee, I have, by means of a glue mould, as before described, made a cast of a deformed fœtus, which has become extremely wrinkled, flaccid, and tender, so that no substance, but a yielding one, could have been applied, and again removed, without injuring the original. By making the mould of an *elastic* or yielding material, this point has been completely obtained.

Even supposing the fœtus could have been moulded as usual, either by plaster of Paris, in many parts, or by pressing clay, or soft wax, upon it, the operation was performed with one-tenth of the trouble by the glue mould; but the original, would not allow of a hard unyielding substance, like plaster of Paris, being removed, without injuring it; nor would it bear the pressure of clay, or soft wax, sufficiently to take an impression. I, therefore, am well convinced, no plan, but an *elastic* mould, could have been employed to procure a cast of the fœtus, without injuring it, as it is in so tender a state.

But it is not in making casts from soft substances, that I consider the *principal* advantage of moulding in glue consists, although, in this department, it is highly advantageous, and will take some preparations, of this kind, which cannot be done by any other means. The great difficulty in casting, is to be able, where it is required, to make a mould which will deliver where there are undercut parts, or hollows, or where there is what is called a dove-tail; now this can only be effected by means of an *elastic* mould, and I have found nothing better for that purpose, than glue, as before described. I am well aware that soft wax has been long employed to form moulds upon hard bodies; but where there are several undercut, or hollow parts, or parts that project, in the subject to be moulded, the wax not being *elastic*, cannot return accurately to its proper position, when removed from the body. More fully to explain this, I have made a cast of a calculus, which could not possibly have been produced by any other mode than that of having an *elastic* mould; soft wax could not have been removed from the undercut parts, without having its form injured; now the glue gives way, whilst being removed, and returns to its former position, or shape, when so removed, which enables the parts to be accurately represented.

I therefore consider the principal advantage of my plan, to consist in the moulds being *elastic*, and consequently capable of removal from hollows, and undercut parts, by giving way, and again returning to their proper forms. This great desideratum in casting, can-

not, in numberless instances, be obtained by any other means. The glue moulds are also, in common instances, much more expeditiously employed than others.

The fœtus having been oiled, was surrounded by two silk threads, previous to the glue being poured upon it, so that when the threads were drawn out, they cut the mould into three pieces; the situations of these divisions, are seen by the seams left upon the preparation. This being done, the elasticity of the glue allowed every part to be removed without the slightest injury. There is no novelty in using thread, as here described.

The mould of the calculus, was merely cut into two parts, which allowed each half to be removed from the stone; they being again placed together, were ready for use, that is, for the plaster to be poured in.—*Ib.*

ESSAYS ON BLEACHING.

By James Rennie, A. M. Lecturer on Philosophy, &c. &c. London.

No. III.—CHEMICAL AGENTS USED IN BLEACHING.

Section IV.—*Soap.*

Very considerable quantities of this article, are used in the several stages of bleaching; chiefly for washing the goods, and, at the conclusion of the other processes, for finishing them, and giving them that gloss and silky softness, in handling, which insures them a ready sale. Like most of the chemical manufactures, soap-making is commonly but little understood by those who are engaged in it, and, consequently, when brought to market, different parcels are very unequal in value. They are commonly ignorant of the proper characteristics of good tallow, which should be as free as possible from sebacic acid; and they are seldom acquainted with the proper method of oxidizing the soap, while boiling; of allowing the alkali a full opportunity of forming a chemical combination with the oil or tallow; and of producing, from potash, a firm consistent soap. Rumford's improvement of boiling by steam, by which a percussion is given to the tallow and the ley, is still less known, (Phil. Mag. XXIX. 283.)

For this manufacture, it is necessary to use a fixed alkali, in a state of causticity. The soap-makers here, take a large quantity of Scotch, or Irish kelp, or Spanish barilla, break it to pieces, grind it coarsely by a horse mill, and when they have mixed it with a sufficient quantity of quicklime, to absorb the carbonic acid, they throw the whole into large wooden, or iron vats, and cover it with water. At a proper time, this liquid, now formed into alkaline ley, is let off into iron receivers below, and the vats are again filled with water, and when impregnated with alkali, this also is let off into the receivers. When a proper proportion of this ley has been prepared, a quantity of Russian, or English, tallow is put into a large iron boiler, and melted with the ley. At first, the tallow appears liquid,

like oil, but during its boiling, it gradually thickens. When most of the alkali of the first portion of ley, has united with the tallow, the weak liquor is pumped from beneath, and fresh leys are added in their stead, which are boiled as before, till the whole acquires a proper consistence, when it is cooled, and prepared for sale. In making yellow soap, which, however, is seldom used in bleaching, one-third, or one-fourth part of rosin is added to the tallow, or to fish oil, which renders the article considerably cheaper. In making soft soap, again, which is much used in the bleachfield, potash, and not soda, is used, as the latter unites too firmly with oil, to be fit for this purpose. Soft soap contains a great proportion of water.

The alkali, renders the oil or tallow, soluble in water, and thus the whole is made capable of uniting with, and removing such extraneous substances as are combined with, or adhere to, the cloth. The tallow itself could never effect this, for though it might combine with such extraneous matters, it could not disengage them; the alkali, again, would of itself act too violently, and could not be handled, with safety, by those employed in washing, for it could not be used to any advantage as a detergent, except in a state of causticity. On the other hand, it is, undoubtedly, the tallow of the soap, which gives goods that softness, and smoothness, which are so requisite to make them saleable: when they are taken from the leys, or the sours, or even after crofting, they always have a hard feel, which makes them appear *hask*, as the Scotch bleachers express it, and much coarser than they really are. To accompany the soap, good soft water however, is indispensable, and no finishing can be perfect, without this can be had, in abundance.

SECTION V.—*Sulphuric Acid.*

This is a substance of very great importance in bleaching, upwards of two thousand tons being annually consumed for this purpose, in Britain, and Ireland. It is made by mixing a quantity of sulphur, with an eighth of its weight of dried nitre, for affording a supply of oxygen, and burning the whole, which kindles spontaneously, in very large leaden chambers, according to a plan invented by Dr. Roebuck, and well known. The floor of the leaden chambers, some of which are as large as 96,000 cubic feet, is covered with water, in order to condense the acid, as it is formed during combustion. This quantity of water is indefinite, but when it is found, upon trial, to have been impregnated to a sufficient extent, it is drawn off, or concentrated by boiling. The time for removing it, is either indicated by its assuming a black tinge, or by examining its specific gravity, which should be about 1.350, or 1.450, although it is commonly allowed to acquire that of 1.560. When the water in the chambers comes to so high a specific gravity, it refuses to absorb the gas, with avidity, and could not be carried, in this way, to a high state of concentration. When in the boiler, again, it is equally necessary to draw it off before it becomes too much concentrated; for the boiling point of sulphuric acid always increases with its specific gravity, and its boiling point is very near to that, at which lead melts; acid, of the specific gravity,

1.848, boiling at 590°; of 1.849, at 605°; and lead melting at 612°. There is, consequently, great danger of the metal giving way, and loss would likewise ensue from the decomposition of the acid, while all the remainder would be much contaminated with lead.— Some manufacturers omit the boiling altogether, in order to avoid contamination with lead, and the bleacher should always prefer acid so manufactured, when it can be procured.

After the process of boiling, it is farther concentrated in glass retorts, where it receives a greater quantity of heat, for drawing off the water, than in the boilers. It is one of the most ponderous fluids with which we are acquainted. It is usually sold of a specific gravity of 1.846, or 1.850, being nearly twice that of distilled water. When pure, it is a transparent and colourless liquid, extremely acid and corrosive, but entirely devoid of smell, and slightly viscid. It is commonly, less, or more, contaminated with lead, and super-sulphate of potash, arising from the mode of manufacturing it. The lead is taken up, in small quantity, from the chambers in which the combustion is carried on, and in the steaming boilers, a sulphate is thus produced, and is subsequently fixed by the process of concentration. This sulphate is often perceptible, in the form of a white powder, at the bottom of the carboys, (sulphuric acid bottles,) when by any accidental cause it is precipitated. The super-sulphate of potash is sometimes fraudulently mixed with the sulphuric acid of commerce, but must always exist in it, in small quantity; for, after the combustion of the sulphur, and nitre, in the leaden chamber, the super-sulphate of potash, is left as a residuum, from the affinity of the potash contained in the nitre, for sulphuric acid, and is consequently taken up, and held in combination. When this adulteration is made on purpose to increase the specific gravity of the acid, and defraud the buyer, the manufacturers add a strong solution of the salt, to the water introduced into the lead chambers, which, in consequence of affinity, readily unites with the acid when it is fermenting. When this adulteration is in considerable proportion, and it is frequently as high as a fifth of the whole, the acid is rendered wholly useless for bleaching. This should put bleachers carefully on their guard, in making purchases.

It may not be improper to mention, although it could scarcely be practised on a large scale, that those impurities can be precipitated by adding distilled water to the adulterated acid, and this, again, may be removed by evaporation. This might, perhaps, be turned to account in examining the quality of acid, about to be purchased. A method has been proposed by Mr. Accum, (Nich. 4to Jour. I. 118,) to detect the several impurities which contaminate sulphuric acid. He directs to dilute a small quantity of the acid, to be tried, with distilled water, and to saturate it with pure vegetable alkali, which will precipitate either copper, iron, or lead, in the form of a more or less dark coloured powder. This is to be separated by the filter, washed with distilled water, and treated with pure ammonia, which, if copper be present, will acquire a blue colour. This blue liquid is to be poured off, and the residuum washed in distilled water, and

dissolved in pure muriatic acid. To ascertain the presence of lead, mix this solution with an equal quantity of water, impregnated with sulphureted hydrogen gas, which, if the acid contain lead, will throw down a black, or dark brown, precipitate. Iron may be detected by prussiate of potash, or tincture of galls. Potash is more difficult to discover: strong ardent spirits will precipitate it in the form of a white powder, if, as is seldom the case, it be not in small quantity. Or a portion of the acid may be saturated with carbonate of ammonia, and a little tartaric acid, added to the solution, when the potash will be indicated under the form of a tartarate.

I believe it is not common for bleachers to be incommoded by the freezing of sulphuric acid, but it is proper that they should be aware of its liability to freeze. The circumstances attending the freezing of this acid, were first distinctly related by Mr. Kier, in the Philosophical Transactions for 1787. Whenever such an accident happens to the manufacturer, it is a proof that it has not been sufficiently concentrated. In winter, then, when a bleacher has much sulphuric acid on hand, he ought to be very circumspect in bringing it to a proper state of concentration. The specific gravity of 1.780, is the middle point of the degree of easy congelation. At 1.790, or 1.770 of specific gravity, it will not freeze, even in melting snow. In severe winters, then, we may infer, that it would not be safe to keep the acid in glass vessels, at any specific gravity between 1.720 and 1.790. Parkes relates an instance, (Chem. Ess. II. 457) in which this property of the acid defeated, most effectually, the fraudulent designs of the manufacturer. Parkes had instructed him in the method of rendering the acid pellucid, without subjecting it to concentration, in the glass retorts. Exulting in the important discovery, he immediately prepared for his customers, a hundred carboys of the requisite transparency, but weak from being much diluted. It happened in winter; a severe frost ensued; the acid was within the limited degrees of freezing, in which case, according to Kier, it freezes even more rapidly than water. It consequently froze, and the carboys, bottle after bottle, would have burst, by expansion, had they not been placed in tepid water.

A bleacher who may be only in his rudiments of chemistry, when he is taught, that sulphuric acid has so strong an affinity for water, as to attract it even from the atmosphere, will be apt to be alarmed lest his acid be spoiled by keeping; but it is only when it is much concentrated, that it attracts much water. It follows the general law of chemical combination, that in proportion as the point of saturation is approached, the attraction is either weakened, or is slower in its action. Besides, it is always used in a much diluted state in bleaching, and, therefore, his alarm can only be well founded, when he is in the act of making a purchase. A bleacher, ignorant of chemistry, would not be likely to give any credit to this doctrine of the acid's absorbing water; but he might be readily convinced, by dipping the bulb of a thermometer in the concentrated acid, which will not probably affect the thermometer; but on withdrawing it, the small portion of acid which adheres to the bulb, will absorb water from the

atmosphere with so much rapidity, particularly in damp weather, that in a few seconds, the mercury will rise several degrees.

There is another circumstance, the knowledge of which, slight as it seems, may sometimes be of use in saving time, namely, that sulphuric acid, when heated, has a remarkable property of retaining its caloric, or of imparting it more slowly to the bodies around it, than other substances generally do. Now the violent heat which is produced on mixing the acid with water, would, in the case of water alone, split any glass vessel into which it might be poured. But in consequence of this property of retaining caloric, it may be poured with perfect safety from the retort into the carboys, at the temperature of 200°; there need be no delay, therefore, in waiting for its cooling, from apprehension of breaking the bottles.

In diluting sulphuric acid for bleaching, care should be taken to add the acid to the water, and not the water to the acid; for if the latter be done, part of the mixture will fly up, and endanger the face of him who may thus act so incautiously. It is best to invert the neck of the carboy, under water, when the acid will leave it, from its superior gravity. The acid should be added gradually, and in successive portions, and be suffered to rest a sufficient time between each addition, that a complete union between the acid and the water may take place; as, even when cold, a mixture of the acid with water, takes several hours to arrive at a maximum of condensation.

It is a great desideratum with bleachers, to have a ready method of ascertaining the real quantity of acid, in that which is diluted. The readiest mode that can be had recourse to, is the tables published in Parkes' Chemical Essays, which I content myself, in the meantime, with merely referring to. One of those tables shows the real quantity of sulphuric acid, at every degree of density.

I may mention here, a remark that may be found to be of importance in constructing extensive bleaching works, namely, that the fumes of sulphuric acid will soon destroy the beams and rafters of the house where the souring process is carried on. Bricks, therefore, are recommended for building such a house. If wood be used, it ought to be well defended by several coatings of the pyroligneous acid. This is gently heated in an iron pot, and put on with a brush. (Parkes, II. 274.)

Sulphuret of Lime was strongly recommended as a detergent, by Mr. Higgins, of Dublin, in a work which he published in 1799, on the Theory and Practice of Bleaching, but it does not seem to have ever come into general use. It was tried also, in several of the bleaching establishments in France, but was laid aside, after the publication of several accurate experiments on it by Citizen Potel of the Academy of Dijon, who proved that it could not be of any use in bleaching, without admixture.—See Phil. Mag. XIV. 199.

ENGLISH PATENTS.

Specification of the Patent granted to CHARLES BAGENALL FLEETWOOD, *of Parliament-street, Dublin, Gent. for a liquid, and composition, for making leather, and other articles, water-proof.* Dated February 28, 1824.

MY new invented liquid and composition for making leather, and other articles, water-proof, consists of a certain compound of resinous, oleaginous, and elastic matters, the proportions of which, and the mode of mixing, I am about to describe. My process is as follows; I dissolve 10 lbs. of caoutchouc, or Indian rubber, in twenty gallons of pure spirits of turpentine, by putting them both into a tin vessel capable of holding at least 35 gallons, 40 perhaps would be as well; the caoutchouc should be cut into pieces, or slices, of about $\frac{1}{16}$th part of an ounce weight, to hasten the solution. I then immerse the vessel into a boiler, previously filled with cold water, and apply the fire so as to produce the boiling of the water, occasionally supplying the waste, caused by evaporation. In this situation it remains until a perfect solution of the caoutchouc, in the spirits of turpentine, is effected; I then dissolve 150 lbs. weight of pure bees-wax in 100 gallons of pure spirits of turpentine, adding thereto 20 lbs. of Burgundy-pitch, and 10 lbs. of gum-frankincense. The solution of these articles, I obtain by the same means as described for dissolving the caoutchouc. To these two matters or solutions, when mixed together, I add, after they are quite cold, 10 gallons of the best copal varnish. The whole of these materials are then to be put together in a large reservoir, where the compound may be diluted by adding 100 gallons of lime-water, pouring in five gallons at a time, and stirring it continually for six or eight hours; which agitation must be repeated whenever any of the composition is taken out of the reservoir, either to be bottled, or casked. In order to colour this composition, when it is required to be rendered black, 20 lbs. weight of the best lamp-black should be mixed up with 20 gallons of the purest turpentine spirits (which 20 gallons should, under these circumstances, have been deducted from the previous mixture); this, when properly blended, is to be added to the composition, but that should be done previous to the introduction of the lime-water. The composition, when thus prepared, is to be laid upon the leather by means of a painting brush, and rubbed into the surface, which will render the leather, after the composition has become dry, impervious to water, and at the same time perfectly soft and pliable. Though I have thus minutely described the comparative proportions of each material, yet I do not mean to confine myself precisely to those respective quantities, nor to the precise mode adopted in mixing and preparing them, but have stated such proportions and such process as the best that I am acquainted with, and which I am, from considerable experience, induced to adopt, and recommend.

Repert. Pat. Invent.

Patent granted to Thomas Hughes, *of Newbury, Berkshire, Miller, for improvements in the method of restoring foul or smutty wheat, and rendering the same fit for use.* Dated May 23, 1826.

The process used for effecting the purposes mentioned in the title, consists, first, in immersing the smutty wheat, in water; where it is let to lie but a short time, lest the internal part of the grain should imbibe too much moisture. The heavy grain falls to the bottom of the vessel, but that which is decayed, and the smut balls, rise to the surface, from whence they are to be skimmed off, and removed. 2dly. The wet grain is to be put into baskets, or loosely woven bags, to drain. 3dly. When the wheat ceases to drip, it is to be removed to a trough of the following construction, lined with linen, or woollen cloths, and is there to be well rubbed with other cloths of the same description. The trough is about three feet broad, and of a length suitable to the quantity of wheat, which is desired to be operated on, in it, at one time; its bottom is formed of laths or battons, laid together so as to let water pass through; and one of its ends is made to draw up, to facilitate the removal of its contents. Lastly. The grain is to be taken from the trough, and to be spread out in the sun on a clean surface, or on the floor of a moderately heated kiln, until thoroughly dried; when it is to be stored away for consumption.

In some cases, bran, or pollard, may be mixed with the wet wheat to cause it to dry more speedily, which is to be afterwards separated from it by sifting.

The patentee states, that cloths somewhat damp, will remove the moisture from the grain more speedily, than if they were completely dry, and therefore directs, that those used in the foregoing process should be previously dipped in water, and afterwards wrung out so as to discharge as much as possible of what they had imbibed. He also mentions that machinery may be employed in rubbing the wheat dry; and that, though he prefers the trough described, other vessels may be used for the same purpose.—*ib.*

To Francis Melville, *of Argyle street, in the City of Glasgow, Piano-forte maker, for his invention of an improved method of securing that description of small Piano-fortes commonly called Square Piano-fortes, from the injuries to which they are liable from the tension of the strings.*

The intention of the patentee, is to produce that sort of firm bracing, in the interior of square piano-fortes, that the framing shall not be capable of warping, or being drawn out of its primitive form, by the great tension of the wires. For this purpose, there are firmly fixed by screws, or otherwise, on the rest board or blocks into which the pins are set that stretch the wires or strings, metallic brackets,

with a circular hole in each, to receive the end of a strong metallic rod, which is intended to form a substantial resistance against the tension of the strings, and, by that means, prevent the frame-work from being drawn out of its original shape.

The brackets are simply right-angled pieces of metal, firmly screwed to the rest boards of the instrument; the upright part of each bracket has a circular hole near its top, sufficiently high to be above the wires. The rods are formed with spherical ends, which are let into the circular holes of the brackets, and by their resistance, prevent the wood work from giving way, whatever may be the force with which the wires may be drawn.

Various contrivances have been proposed, for giving stability to the interior of piano-fortes, in order to resist the tension of the wires; the particular novelty therefore, of the present invention, is the peculiar method of attaching the tension rods, by means of spherical ends let into circular holes in the brackets.—Enrolled March, 1825.

[*London Journal of Arts.*

FOR THE FRANKLIN JOURNAL.

MECHANICAL JURISPRUDENCE.—No. XVII.

BY PETER A. BROWNE, ESQ.

On the Law of Patents for New and Useful Inventions.

THE REMEDY PROVIDED BY LAW FOR A BREACH OF THE PATENTEE'S PRIVILEGES.

The fifth section of the act of Congress, of 1793, provided, "That if any person shall make, devise, and use, or sell the thing so invented, the exclusive right of which, shall, as aforesaid, have been secured to any person, by patent, without the consent of the patentee, his executors, administrators, or assigns, first obtained in writing, every person so offending, shall forfeit and pay the patentee a sum that shall be, at least, equal to *three* times the price for which the patentee has usually sold, or licensed to other persons, the use of the said invention; which may be recovered in an action on the case founded on this act, in the circuit court of the United States, or any other court having competent jurisdiction."

This section was repealed by the 4th section of the act of Congress of the 17th April, 1800.

The third section of the last mentioned act of Congress, is in these words. "That where any patent shall be, or shall have been granted, pursuant to this, or the abovementioned act, and any person, without the consent of the patentee, his or her executors, administrators, or assigns, first obtained in writing, shall make, devise, use, or sell the thing, whereof the exclusive right is secured to the said patentee, by such patent, such person so offending shall forfeit and pay to the said patentee, his executors, administrators, or assigns, a sum equal to

three times the actual damage sustained by such patentee, his executors, administrators, or assigns, from, or by reason of such offence, which sum shall and may be recovered by action on the case, founded on this and the abovementioned act, in the circuit court of the United States, having jurisdiction thereof."

The action is *on the case*, by the express words of the act of Congress. So, in England, the form of the action is on the case. Godson on Patents, 176. 1 Chit. plead. 142.

THE COURT IN WHICH THE ACTION MUST BE BROUGHT.

Formerly, in England, patent rights were investigated in the court of Star Chamber, 3 Inst. 183. By the second section of the statute of James, it is declared, "that all monopolies, and all such commissions, grants, licenses, charters, letters patent, &c. ought to be, and shall be forever thereafter, examined, heard, tried, and determined, by and according to the common law of the realm, and not otherwise." They are, therefore, now cognizable by the courts of law and equity.

In the United States, a suit brought for the infringement of a patent right, must be in the circuit court of the United States.

It has been decided in the case of the Bank of the United States *v.* Deveaux, 5th Cranch, 85, that in cases arising under the laws of the United States, unless jurisdiction be conferred by act of congress, the circuit court of the United States cannot interfere. So, although patent rights depend upon the laws of the United States, yet to justify the jurisdiction of the courts of the United States in sustaining suits by the patentee, it was required, expressly, to recognize his right to sue, in the laws respecting them.

A state court has no jurisdiction in an action brought for the infringement of a patent right.

This was decided in Parsons *v.* Barnard, 7 Johnson's N. Y. rep. 144.

It was an action on the case for a breach of the plaintiff's patent for an improvement in rectifying spirits. The defendant pleaded to the jurisdiction, and the plaintiff demurred. The court gave the following opinion. "The act of congress of the 17th April, 1800, (vol. 5, page 88,) declares, 'that whenever any patent right shall be infringed, the party offending, shall forfeit a sum equal to three times the actual damage sustained, which sum shall be recovered by action on the case, founded on the act, &c. *in the circuit court of the United States, having jurisdiction thereof.*'

"The act of Congress, of 21st February, 1793, (vol. 2, p. 203,) also declares, that, in certain cases, when judgment shall be rendered for the defendant, the patent shall be declared void. As the judicial power of the United States extends to all cases in law, and equity, *arising under the laws of the United States*, and as the act of congress, on the subject of patent rights, has declared, that the suit for the infringement of them, shall be brought in the circuit court of the United States, and gives the court power, in such cases, to declare the patent void, the state courts have, of course, *no* jurisdiction in the case; and judgment must be rendered for the defendant.

The District Courts of the United States have jurisdiction over patent cases, so far as to enquire whether a patent was obtained surreptitiously, or upon false suggestions. This proceeding, which is directed by the 10th sect. of the act of 1793, will be explained hereafter.

THE FORM OF THE DECLARATION.

In an action in England, for infringing a patent right, the declaration states, that the plaintiff was the true and first inventor; that the letters patent issued, making profert of them; setting them forth; the enrolment of the specification; the using and exercising of the invention by the plaintiff; the infringement by the defendant; and the damage. See 2nd Chitty's Plead. 320.

In the United States, the declaration is of the same tenor, and the plaintiff must support, by proof, all the material allegations in his declaration.

He must prove that he is the inventor; that the invention is new, and useful; that a patent has been granted to him; that his invention produces the required effect; that the defendant has infringed his right; and the amount of damage.

1st, *That he is the inventor.*

This is laid down by Godson, in his Essay on Patents, p. 178; and although he cites no authority, I have no doubt but it is good law. The same thing was decided in the United States, in the case of Evans v. Kreemer, 1 Peters' C. C. Rep. 215.

2nd, *That the invention is new and useful.*.

In Bovill *v.* Moore, Davis' Patent Cases, 399. Chief Justice Gibbs says, "In point of law, it is necessary that the plaintiff should prove that this is a new, and useful invention, in order to entitle himself to the present action." And in Manton *v.* Manton, same book, 348, 9, the same learned Judge says, "In order to support a right to the exclusive enjoyment of any invention, it is necessary that the party who takes out the patent, should show that the invention is new, that it was unknown to the trade, and to the world, before; that it is not only new, but that it is useful to the public, &c."

Slight evidence, is all that will be required on the above points, in the first instance.

3d, *That a patent has been granted to him.*

By the common law, *a constat*, or *inspeximus*, of the king's letters patent, could not be shown forth in court, but the letters patent themselves, must have been produced; but by statute 3 and 4 Ed. VI. c. 4, explained by statute 13 Eliz. c. 6., "patentees, and persons claiming under them, may make title in pleading, by showing forth an exemplification of the letters patent, as if the letters patent themselves were pleaded and shown forth;" and now they are to be given in evidence in the same manner as if they were pleaded. Godson on Patents 178, and the authorities there cited.

The act of congress of 1793, in the 1st section, declares, "that the letters patent, signed by the President of the United States, and sealed with the seal of the United States, shall be delivered to

the patentee, or his order, and *shall be good and available to the grantee or grantees by force of that act.*"

And in the 3d section, speaking of the description, says, "which description, signed by himself, and attested by two witnesses, shall be filed in the office of the Secretary of State, and certified copies thereof, shall be competent evidence, in all courts, where any matter or thing, touching said patent right, shall come in question."

The letters of the plaintiff, to the Secretary of State, containing applications for a patent and specifications forwarded by him to the secretary's office, certified under the seal of that department, as papers remaining in that office, are evidence for the plaintiff.

Daniel Pettibone sued Henry Derringer, for an alleged infringement of his patent, dated the 12th of February 1814, for a new, and useful improvement in boring musket, pistol, and rifle barrels, by an auger called the spiral, groove, or twisted, screw auger.

The defendant pleaded the general issue, and gave notice that he would give evidence, that the thing secured by patent, was not originally discovered by the plaintiff, but had been in use anterior to the supposed discovery, or that he had surreptitiously obtained a patent, for the discovery of another person.

The plaintiff, in order to maintain this issue on his part, offered in evidence, a certified copy of a letter, from himself, to the Secretary of State, dated 21st of January, 1799, containing a specification of an improvement in boring muskets, &c., certified under the seal of that department, as papers remaining in the office. This evidence was objected to, but was admitted by Washington, Justice.—MS.

4th, *That the invention produces the desired effect.*

This rule depends upon the authority of Mr. Justice Buller, in Turner *v.* Wilson, 1 Term Rep. 606—7. He says, "Wherever the patentee brings an action on his patent, if the novelty, or *effect*, of the invention be disputed, he must show in what the invention consists, and that *he produced the effect proposed by the patent, in the manner specified.*"

5th, *That the defendant has infringed the right.*

The exclusive privilege granted to the patentee, is of *making* and *constructing*, as well as using, and vending. The words are, "and thereupon granting to such petitioner, &c., the full and exclusive right, and liberty, of making, constructing, using, and vending to others to be used, the said invention, or discovery."

It is no breach of the patent, to construct a machine, merely for philosophical experiments, or for the purpose of ascertaining the sufficiency of the machine to produce its desired effects.

This was admitted in Whittemore *v.* Cutter, 1 Gallisson's rep. 429. But, *the making of a patented machine fit for use, and with design to use it for profit, in violation of the patent right, is of itself a breach of the patent right, for which an action lies.*

This was decided in Whittemore *v.* Cutter, 1 Gallisson's Rep. 429. It was an action for the violation of a patent right in a machine for making cotton and wool cards. One objection taken to the direction of the court, was, that the jury were instructed that the making of a

machine fit for use, and with design to use it for profit, was an infringement of the patent right, for which an action was given by the act of congress.

Judge Story observed, "It is now contended by the defendant's counsel, that the making of a machine, is, under no circumstances, an infringement of the patent. The 1st sect. of the act of 1793, expressly gives to the patentee, &c. 'the full and exclusive right and liberty of making, constructing, using, and vending to others to be used,' the invention or discovery. The 5th sect. of the same act gives an action against any person who 'shall make, devise, and use or sell' the same. From some doubt, whether the language of the section did not couple the making and using together, to constitute an offence, so that making without using, or using without making, was not an infringement, the legislature saw fit to repeal that section; and by the 3d sect. of the act of 17th April 1800, ch. 25, gave the action against any person who should 'make, devise, use, *or* sell' the invention. We are not called upon to examine the correctness of the original doubt, but the very change in the structure of the sentence, affords a strong presumption, that the legislature intended to make *every one* of the enumerated acts, a substantive ground of action."

"It is argued, however, that the words are to be construed *distributively*, and that 'making' is meant to be applied to the case of a composition of matter, and not to the case of a machine. That it is clear, that the use of certain compositions (as patented pills) could not be an infringement, and unless *making* were so, there would be no remedy, in such cases. We cannot feel the force of this distinction. The word 'making' is equally as applicable to machines, as to compositions of matter; and we see no difficulty in holding, that the using or vending of a patented composition, is a violation of the right of the proprietor."

"It is further argued, that the making of a machine, cannot be an offence, because no action lies, except for *actual damage;* and there can be no actual damages for an infringement by *making* a machine. We are, however, of opinion, that where the law gives an action for a particular act, the doing of that act, imports, *of itself*, a damage to the party. Every violation of a right imports *some* damage, and if none other be proved, the law allows a *nominal* damage."

If the manufacture made by the defendant be essentially and substantially the same as the one patented, it will be an infringement, though there be a departure from the specification.

This was decided in Hill *v.* Thompson, 2 B. Moore, 447.

Dallas, J., said, "But it is contended that this is a patent for a combination of processes altogether new, leading to one end; and this being the nature of the alleged discovery, any use made of any of the ingredients, singly, or used in partial combination, omitting some, and making use of all, or some, in proportions essentially different, and yet producing a result equally, if not more beneficial, will constitute an infringement of the patent. It is scarcely necessary here to observe, that a slight departure from the specification for the purpose of invasion only, would of course be a fraud upon the patent;

and therefore the question will be, whether the mode of working, by the defendant, has, or has not, been *essentially* or *substantially different.*"

The sale of the materials of a patented machine, by a sheriff, on an execution against the owner, is not such a sale as subjects the sheriff to an action for an infringement of the patent right.

Sawin had a patent for cutting brad nails. The defendant was the sheriff of his county, and having an execution against him, seized and sold the materials of three of the machines. This seizure and sale, was the alleged infringement.

It was contended that, by the 3d section of the act of 17th April, 1800, any person who shall, without the consent of the patentee first obtained in writing, make, devise, use, or *sell* the thing, whereof the exclusive right is secured, shall forfeit, &c.

The court were clearly of opinion that this was not the construction of the act. That a sale of a patented machine, within the prohibition of this clause, must be a sale, not of the materials of a machine, either separate or combined, but of a complete machine, with the right, express or implied, of using the same in the manner secured in the patent. It must be a tortious sale, not for the purpose, merely, of depriving the owner of the materials, but of the use and benefit of his patent. Sawin, &c. *v.* Guild, 1. Gallissons' Rep. 485.

Whether the acts of the defendant amount to an infringement, is a question of fact for the jury. 2 H. Black, 480.

Presumptive evidence of infringement may be received.

In the case of Huddard *v.* Grimshaw, which was an action for a breach of a patent right to make ropes in a peculiar way, the court admitted evidence that the defendant had requested liberty to use the invention, which was refused, and that he afterwards carried on his business in secret, and refused to permit a friend of the plaintiff's to inspect his ropewalk; and that upon inspecting the ropes made at the defendant's walk, witnesses, well acquainted with the manufacture, believed they were made according to the plaintiff's method.

THE AMOUNT OF DAMAGES.

The damages which are to be trebled are compensatory, and not exemplary.

The words of the act of congress are, "a sum equal to three times the *actual damage* sustained by such patentee," &c. Third section of the act of 1800.

So in Whittemore *v.* Cutter, 1 Gallisson's Rep. 478, the court say, "As to the rule by which the plaintiff's damages are to be estimated, it is clear, by the statute, that only the *actual* damage sustained, can be given. By the term 'actual damages,' in the statute, are meant such damages as the plaintiff can actually prove, and has *in fact* sustained, as contradistinguished from mere imaginary or exemplary damages, which in personal torts, is sometimes given. The statute is highly penal, and the legislature meant to limit the single damages

to the real injury done, as in other cases of violation of personal property, or of incorporeal rights."

When the defendant has used the machine, &c. the measure of damages should be the value of the use of the machine during the time used.

This also is decided in Whittemore *v.* Cutter, 1 Gallisson's Rep. 483. The court say, "If the jury are of opinion that an user of the machine is actually proved, the rule of damages should be the value of the use of such machine, during the time of the illegal user."

In estimating the damages, the jury have no right to take into their consideration the counsel fees.

This is established by the case of Arcambel *v.* Wiseman, 3 Dallas's Rep. 306. The circuit court of the district of Rhode Island, had decreed, among other things, the payment of 1600 dollars for counsel fees for the court below, and the supreme court of the United States struck this sum out. They said, the general practice of the United States, is in opposition to it; and even if that practice were not strictly correct, in principle, it is entitled to the respect of the court, till it is changed or modified by statute.

This case is cited in the case of Whittemore *v.* Cutter, 1 Gallisson's Rep. 438 and a decision given conformably thereto.

The jury find the single damages, and the court treble them. Whittemore *v.* Cutter, 1 Gallisson's Rep. 484.

PERKINS'S STEAM ENGINE.

In our last number, we prefaced two extracts from foreign journals, upon the subject of Mr. Perkins's Steam Engine, with some remarks, tending to show we had but little hope, that the high expectations which had been excited respecting this machine, would ever be realized. We have just received a long, and highly interesting letter, from Mr. Perkins, upon the subject of his engine, together with a pamphlet, written by him, "On the Explosion of Steam Boilers," and "On the Economy of using Highly Elastic Steam, Expansively, &c." This pamphlet had not been published in England, at the date of Mr. Perkins's letter. The first part of it, we now present to our readers; the latter part requiring a plate, or cut, must be delayed, until the next month.

We have said, that the letter from Mr. Perkins, is highly interesting, and as we are certain his countrymen will be glad to hear him speak for himself, we publish it entire, with the exception of some free remarks upon individuals, which were intended for the eye of confidential friendship, alone.

Mr. Perkins complains, and we are sure, justly, that a great deal has been published respecting his engine, which, from its absurdity, has tended to bring the machine into disrepute. For ourselves, we confess, that we had ceased to anticipate much from it, and were among those who thought, that Mr. Perkins had attempted impossi-

bilities; to sign our recantation, however, will afford us the most sincere satisfaction: this is one of those tasks from which we shall never shrink, although we instinctively shudder, and incline sideways, when we think of sitting along side a generator, subjected to a pressure of 3000 lbs. to the square inch.

The remarkable fact, discovered by Mr. Perkins, that neither steam, or water, will issue through a fissure in a highly heated generator, is we think in perfect accordance with admitted principles of science, although it is one we should never have anticipated. It is worthy of particular attention, and if it stood alone, would entitle its discoverer to great credit.

The following advertisement, from a London paper, accompanied the communication of Mr. Perkins.

"The High Pressure Safety Steam Engine.—Perkins and Co. are now ready to receive orders for steam engines. They will guarantee the saving of, at least, one half of the fuel, three-fourths of the weight, and three-fourths of the bulk, and will charge but two-thirds the price of the best, London made, condensing engines; reserving the right to one-third of the savings. Orders and communications left at Perkins and Heath's, No. 69, Fleet-street, will be attended to." [*Editor.*

Intelligence respecting the HIGH PRESSURE, SAFETY, STEAM ENGINE, *and on various subjects, connected with it; with remarks upon some other engines, which have recently attracted public attention; in a letter to the Editor of the Franklin Journal, from* JACOB PERKINS, Esq.

London, March 8th, 1827.

My Dear Friend,—You must attribute my not having written to you at an earlier date, not to want of inclination, but to a desire of being able to communicate the information which I now give you, namely, that my most sanguine expectations are realized, and to the utmost, in the completion of my *High pressure, safety engine.* This I should have been enabled to say, long since, had it not been for the opposition which I have encountered from avaricious, and interested individuals, by whom my course has been retarded, much more than it has by mechanical difficulties, although these have been enough, in all conscience.

Many of my friends, and some of them very scientific men, have expressed great fears, that I had attempted impossibilities; and were of opinion, that steam engines were so well understood, as to leave little that is new, on this subject, to be discovered. I will ask you, and I will allow no one to be a better judge, if it is not new to generate steam of all elasticities, from the minimum, to the maximum, without the least danger? If it is not new, in the generation of steam, to substitute *pressure,* for *surface,* which I consider the basis of my invention? If it is not new, to have a pressure of 1000 lbs. to the square inch, on one side of the piston, while on the other side of it,

all resistance is taken away by a vacuum, and this produced, without an air-pump, or any more water, than is used, in generating the steam? If it is not new, to have invented a metallic piston, which requires no lubrication, and yet is as tight as the piston of an air-pump? If it is not new, to have applied Sir Humphrey Davy's zinc protectors, to steam cylinders, to prevent oxidation? This, I found, took place in my cylinders, when the engine was not at work, after I found that I could dispense with oil. If it is not new, to dispense with the *eduction valve*, and *eduction pipe*, having no other than a small induction valve, and that, so constructed, as to neutralize the pressure, requiring no oil, and very little power, to open, and close it? If it is not new, to allow the steam to escape, at an opening, 250 times larger, than the steam pipe? All this has been effected, as our friend Lukens can avouch, he having witnessed all these facts, as well as myself. And lastly; if it is not new, to have discovered, that steam may be generated, although in contact with water, at all temperatures, without producing corresponding elasticity?

As soon as my last patent is specified here, I will forward it to you, together with the drawings, not only for your inspection, but with a request, that you will forward them to Washington; as a petition to obtain a patent, will accompany them.

I herewith send you a paper, "On the Explosion of Steam Boilers, &c." This paper I have not yet published here, as it might lead to the discovery of my method of correcting the evil arising from generating surcharged steam, before my patent is specified; but as this will be secure, in a very short time, you are requested, if you approve it, to publish the paper in your interesting journal, as I am anxious for its early appearance in my own country. I have, in confidence, given a copy to Dr. Wollaston, to Mr. Faraday, and to several engineers, whom I could trust, and who all agree, that it assigns the true cause of explosions. I long to see, and to converse with you, and my other really scientific friends in the United States, on this, and other interesting points, connected with my engine.

I have had much interested opposition to contend with, since my residence here; but some of the best men in the country have constantly stood by me, or I must have sunk under the pressure. This government have now given the stamp business, to Perkins and Heath, which we should long since have had, and the country thereby have been saved thousands, but for the intrigues of an individual, who is now *sent to Coventry*.

More than a dozen projectors have attempted to make tubular boilers, since I commenced my experiments, of generating steam by small quantities of water, *under pressure;* but for want of pressure, (which is the novelty I claim in my patent,) they have all failed. M'Curdy from New York, who brought out Hawkins's project, was the first who opposed me. He stated, that I had stolen Hawkins's invention, and gave an air of probability to his assertion, by producing such evidence, from the United States, as he hoped would substantiate it. Yet he was altogether ignorant of my method of generating high steam; and indeed there are not, at this day, ten persons

in the world, who are wholly acquainted with it. M'Curdy took out a patent in this country, and sold to the amount of ten thousand pounds; reserving one-third to himself. He has made three small steam boats; one, large enough to take passengers to Richmond, but no one of them ever steamed more than three miles an hour. The quantity of coal consumed, I could not learn; it must, however, have been too great to answer, had there been no other objection, and they have all been abandoned. Of all the methods yet contrived to generate steam, this was the worst. Had the agent in this business, been considered as the representative of the mechanical talents of his country, it would have been most unfortunate; but such is not the case, as there are now here, four Americans, who stand confessedly pre-eminent, viz. Mr. Lukens of Philadelphia, Mr. Wright of New York, Dr. Church, and Mr. Dyer of Boston.

Brown's vacuum engine, has at length given over, although its death was a very hard one. It was, at last, found, that although, at the beginning of the stroke, the mercury showed a vacuum equal to twenty inches, yet his rarefied air became, towards the end of the stroke, more dense than the atmosphere, and there was, consequently, a great loss from its re-action. I had frequently predicted, that this would be the case, and am apprehensive that Morey's explosive engine will be unavailable, from the same cause.

Brown has certainly shown great ingenuity in the variety of mechanical contrivances which he has invented, in order to overcome the difficulties with which he had to contend; his engine was a beautiful piece of mechanism; its appearance was such as caused it to operate like a charm on his numerous visiters, and many were, consequently, induced to take an interest in, and expend large sums of money, to perfect, an instrument from which they calculated to derive large profits. Is it not astonishing, that men of intelligence should not quickly perceive the difference, between condensible steam, and incondensible air? I have already remarked, that at the beginning of the stroke, the barometer indicated a high degree of exhaustion; it sometimes rose to twenty-four inches, yet his piston, if made to approach the end of his cylinder, as closely as in a well made steam engine, could not, from the density of the contained air, pass the dead point. His first engine, you know, raised water ten or twelve feet high, and this was employed to drive a water wheel; in this arrangement, he did not discover how soon his rarified air lost its power; but when he endeavoured to make his engine work with a piston, he began to experience this unanticipated difficulty. By a very clever contrivance, he, *apparently*, overcame this obstruction, but not without great waste of gas. He attached to his engine, a large separate condenser, in which he burnt his gas, professedly, for the greater convenience of condensation; but it was, in effect, nothing more than lengthening his cylinder, which would have produced the same result in a way much more simple; but to have had a ten foot cylinder, with one foot stroke, would, at once, have torn off the mask, by which the true features of the contrivance were concealed; a catastrophe, which the inventor, very naturally, endeavoured, as long as

possible, to avoid. The consumption of gas was enormous; but as he made his own, or drew it directly from the city pipes, no one but himself could tell, how much he used.

Fascinated with the beauty of the machine, there are many who, yet, declare it to be no failure, and that Brown has been used very ill by the *Gas-engine Company*. One gentleman, who had lost much money in this concern, called on me the other day, and expressed great regret that the gas-engine had not been in my hands; I told him that this would have produced but one advantage, that of having lost less money by the concern, as it was not from want of mechanical skill, that Brown did not succeed, but because the laws of nature were against him; that I was pursuing experiments in accordance with those laws; and that in this consisted the difference in the results to be anticipated from his labours, and from mine. This gentleman expressed much surprise, when I explained to him the difference between condensible steam, and incondensible air.

I am now engaged in building steam artillery, as well as musketry, for the French government. The English government would certainly have adopted this invention, had it not been for the gratuitous and false statements of certain engineers, who declared, that although I was able to make a great display at the public exhibition, made by order of government, yet it was delusive: that I had never made a generator which stood for a week, and that I could not keep up the steam for more than two, or three, minutes at one time. These statements obtained credit, the more readily, as any improvement in the art of war, which could be adopted by other powers, and which would have a tendency to place the weak, upon a par with the strong, appeared likely to benefit other countries, more than England.

The French government have determined to give our new system a fair trial. A series of experiments have been made at Greenwich, which were attended by the French engineers appointed for that purpose, by the duke d'Angouleme, together with one of his aids, and prince Polignac. Their report was so satisfactory to the French government, that a contract was immediately made. An English engineer of the first class, and one who is very much employed by this government, has joined me in the guarantee of the four points, which some of the English engineers have doubted; namely, the perfect safety of the generator, its indestructibility, the ability to keep the steam up, at any required temperature, for any length of time, and its great economy.

The piece of ordnance is to throw sixty balls, of four pounds each, in a minute, with the correctness of the rifled musket, and to a proportionate distance. A musket is also attached to the same generator, for throwing a stream of lead from the bastion of a fort, and is made so far portable as to be capable of being moved from one bastion to another. This musket is to throw from one hundred to one thousand bullets, per minute, as occasion may require, and that for any given length of time. It was an observation made in my hearing, by his grace, the duke of Wellington, that any country de-

fended by this kind of artillery, would never be invaded, and I am very confidently of this opinion.

As soon as this machine is completed, it is to be exhibited to this government, and to several engineers from other powers, who are over here, for that purpose. I have no fears for the result, neither has Mr. Lukens, since he witnessed the experiment made for the French government. He saw the steam gun discharge at the rate of from 500 to 1000 balls per minute, and the steam blowing off at the escape valve, during the whole time; he is equally confident with myself, that the steam may be kept up in such a manner as to discharge a constant stream of balls during the whole day, if required. As regards economy, I am within the truth, when I say that, if the discharges are rapid, one pound of coals will throw as many balls as four pounds of powder.

It has been stated, as an objection to the steam gun, that it would take too long to get up the steam, in case of an attack. To this I answer, that a very small quantity of fire will keep the generators sufficiently heated, when there is no water in them: and that when there is any chance of their being suddenly wanted, they should be kept heated in this way. The heat of the generators would last long enough to give off steam; until the fire is sufficiently increased to furnish a constant supply. For naval purposes, this cannot be an objection, as the steam must always be up. Lord Exmouth, after witnessing a few showers of lead, observed, that he believed the time would come, when a steam gun boat, with two steam guns in her bow, would conquer any line of battle ship; and sir George Cockburn said, that the mischief of it was, it would be to nations what the pistol was to duellists, it would bring all, whether strong or weak, upon a par.

To prove the safety of my engine, I have worked it under a pressure of 1400 lbs. to the square inch, or at a hundred atmospheres, and cut off the steam at one twelfth of the stroke; this was merely to manifest what could be done with perfect security. My usual pressure is 800 lbs. per inch, cutting off at one-eighth, and letting the steam expand to below 100 lbs. per inch. I let off at the dead point, at one flash; the manner of doing this I long to explain to you, but must first get my last patent sealed.

I am informed that our friend, Dr. Hare, thinks I have ventured beyond my depth; in this he is not singular, nor do I wonder that such an idea should prevail, after the publication of so many absurd things respecting my engine; I had no knowledge of these publications, and of course had no control over them. Indeed, I have been extremely cautious about publishing any thing myself, or sanctioning it in others; my determination having been first to complete the *essential* improvements of which I have been in pursuit. I presume that you have seen my last paper on the compression of water, air, &c. Its publication by the Royal Society, has created no small sensation among the philosophers of the old school. The council would not have allowed the reading of it, had not Dr. Wollaston and Sir Humphrey Davy witnessed many of the experiments. I shall soon

publish an experiment with which I think Dr. Hare will be pleased, as it will, if I mistake not, prove practically, what the doctor has so ably attempted to establish theoretically, namely, that caloric is matter. The proof is simple and direct, and I am persuaded that, when you see it, you will think it conclusive. I was led to the discovery of this fact by my experiments upon steam; the results of many of which have been very extraordinary, and quite unexpected. One of the most striking, is the great repellent power of heat. I discovered that a generator, at a certain temperature, although it had a small crack in it, would not emit either water, or steam. This fact I mentioned to a very scientific friend, who questioned its accuracy, and to convince him, I tried the experiment; but he concluded that the expansion of the metal must have closed the fissure. To remove every doubt, I proposed to drill a small hole through the side of the generator, which was accordingly done. After getting the steam up to a proper temperature, I took out the plug, and although we were working the engine at thirty atmospheres, nothing was seen, or heard, to issue from the plug-hole; all was perfectly quiet; I next lowered the temperature, by shutting the damper, and opening the furnace door; a singing from the aperture was soon observable, and when a coal was held before it, rapid combustion ensued; nothing however was yet visible; but as the temperature decreased, the steam became more and more visible, the noise at the same time increasing, until, finally the roar was tremendous, and might have been heard at the distance of half a mile. This was conclusive. I should mention that, at the aperture, the iron was red hot.

My belief is, that water cannot be brought into contact with iron, heated to about 1200°, without a force equal to the maximum pressure of steam, which is equal to about 4000 atmospheres, when water is heated to about 1200°. That pressure, would, I believe, keep it in contact with iron at any degree of heat, and the steam would then be as dense as water. It is very evident that if it would require that force to keep the water in contact, heated as it was at the vent hole, thirty atmospheres must be insufficient to effect this: but the experiment affords some data towards answering the question, at what distance from the heated metal the water remained, when under the pressure of thirty atmospheres? We may safely aver, that it exceeded one-eighth of an inch, as the hole was one quarter of an inch in diameter.

After commencing this letter, I ascertained that my patent was likely in a few days to pass the great seal, and have delayed forwarding it, until I could give you some account of the effect upon the minds of those engineers who were open to conviction, of an experiment performed before them. The patent has been sealed, and the engine has had its power, and economy, tested. The result has been so satisfactory, that an engineer, who employs, at least, 300 hands, has taken orders to make engines, (for I license them out,) with the following guarantee, viz. that of saving half the fuel, and three-fourths of the weight and bulk, with less liability of derangement than ordinary engines. This engineer, whose name is Penn, and who is fre-

quently employed by government, is now making an engine for steam navigation, with a *nine* inch cylinder, and *twenty* inch stroke; he joins me in guaranteeing it to be of sixty horse power. It will not occupy more than *one-sixth* of the room, nor exceed *one-sixth* of the weight, of the ordinary Boulton and Watt's engine, of the same power.

I have sent you the last "London Journal of Arts, &c.," which contains some account of my engine, which is nearly correct as far as it goes. It should, however, have stated, that the piston was eight inches in diameter, that it was a twenty inch, single stroke, engine, a good seventy horse power, and consuming but one-fourth of the coal, of a condensing engine. The weight on the end of the lever was three hundred, instead of one hundred and fifty pounds.

You may, my dear sir, depend upon what I have written; it is the result of actual experiment, and there is no fallacy in it. Having succeeded in making a piston which requires no oil, I am determined to ascertain the limits to which pressure can be carried. I am now making a small engine, strong enough to bear 2000 lbs. per inch, and when done, you shall know the result. Nothing but the piston will limit the power.

The victory, which I have obtained, has been a glorious one for me. For the last three months, many of the engineers had declared me insane, as I had asserted, that I could condense, and produce a vacuum under the piston, without either an air pump, or condensing water; but the tables are now turned, and my triumph, over those who have illiberally assailed me, is complete. By the next packet, you may expect drawings, &c. of my engine; and, I hope, within one short year, to take a seat, with my friend, Dr. Jones, by the side of a generator, sustaining a pressure of 3000 lbs. to the square inch; for this pressure on the generator is required to produce a working power of 2000 lbs. to the square inch, upon the piston.

I have several times mentioned the name of our friend Lukens, who is here, and in pretty good health. He has been introduced to many of the first characters, and is considered as very clever, particularly by one of the greatest philosophers, and best judges of the age. His fame is already high, and is rising, but it must of course require a residence here of some time, for him to be estimated, and remunerated, according to his merits.

This letter has been written, a few lines at a time, as I could catch a spare moment, and sometimes at intervals of several days. You likewise know, that the business of writing is one in which I do not profess to be at home; you will, therefore, I am sure, excuse any inaccuracy, or want of connexion, which it may exhibit, and believe me to be, Yours, truly,

JACOB PERKINS.

Observations on Perkins's Improved Steam Engine. By the Editor of the London Journal of Arts, &c.

This important invention, respecting which, such conflicting opinions have been long entertained, appears to be now assuming a shape that will very shortly determine the points of controversy, (viz.) the question of the perfect safety of the engine; its actual power; and the great economy of fuel.

Mr. Perkins's last patent has passed the Great Seal, his recent improvements may, therefore, with safety now be mentioned. The mechanical difficulties against which he has had to contend, in controlling and applying the tremendous power of high pressure steam, has not only absorbed much more time than he anticipated, but has also demanded a greater outlay of money.

The newly constructed engine, to which we have adverted in our preceding number, has been at work for some days, apparently very much to the satisfaction of the few engineers who have seen it. We have been repeatedly present during its performance, and studiously considered its operations, in which we have not been able to detect any fallacy. As, however, we do not mean, at present, to pledge ourselves as to any definite power which the engine is capable of exerting, we shall simply state the manner in which a certain power has been demonstrated in our presence, leaving our readers to draw their own conclusions, from the facts set forth.

The fly-wheel is eight feet in diameter, and the steam, working, as we are informed, at a pressure of twenty-seven atmospheres, caused the piston to perform sixty strokes per minute. The periphery of the fly-wheel being pressed upon by a loaded lever, (called in mechanics,) of the *second order*. The power exerted by the engine at that time, may be known by calculating the amount of force, or friction, acting upon the fly-wheel.

The lever was a wooden bar, about four inches square, bearing upon the periphery of the wheel at the top. The shorter arm of the lever, or distance from the fulcrum to the impinging point, where the pressure acted upon the wheel, was fourteen inches; from thence to the end, that is, the longer arm of the lever was ninety inches. To the extremity of the lever was suspended a weight, making with that of the bar, rather more than one hundred and fifty pounds. From this may be known the actual force overcome, or work done by the engine at that time. By the addition of fifty pounds weight to the end of the lever, the engine laboured, but still worked steadily; by the removal of part of the weight, the speed of the engine became nearly doubled.

The steam, it was said, acted under a pressure of twenty-seven atmospheres, but Mr. P. states, that he usually employs a pressure of fifty-six atmospheres, and that the consumption of coal per hour, is about half a bushel.

Under this pressure of about 800 lbs. upon the inch, the steam is admitted into the working cylinder, and when the piston has de-

scended through one-eighth of its stroke, the ingress of steam is shut off, and the other seven-eighths of the stroke is performed by expansion.

Mr. Perkins's original idea of substituting pressure for surface, in generating steam, (which appears to be the basis of his invention,) has never for a moment been abandoned; and the invention, if satisfactorily established, must certainly be considered as of the utmost importance, particularly in its first feature, *absolute safety*, which could hardly have been contemplated in any other plan of boiler, to the extent which this construction evidently exhibits the capability of effecting. From the mode of constructing the compound generator as now adopted, it becomes a safety valve of itself; for the pressure is divided into so many compartments, that any one of them may explode with impunity, without even disturbing a brick of the furnace. Although in the early part of the invention, many explosions took place, without any attending accident, (which served to show the safety of this method of generating steam, as well as to point out the proper way of constructing the generators,) yet for the last two years, it is said that nothing of the kind has taken place, notwithstanding the steam has been frequently raised to a pressure of above 1500 lbs. to the square inch.

To illustrate the safety of this method of generating steam, let us imagine a few tons of gunpowder to be confined within one compartment, and if ignited, the tremendous effect will be readily anticipated; but let this same quantity of powder be divided into a proper number of compartments, and any one conversant with fire works, would not hesitate to explode it with a match, of not more than a few inches in length. We should not have dwelt so long on this part of the invention, had not the alarm, from the great number of explosions within the last year or two, not only in this country, but in France, and America, created universal terror; particularly in steam-boat travelling; and the danger of explosion would still be more alarming, since it has been recently discovered that the safety valve is of no use, when an explosion takes place from the sudden generation of steam.

We will now mention some of the practical difficulties which Mr. P. has had to contend with. First, the re-action of this highly elastic steam on the eduction side of the piston, occasioned by its density, and expansive property. Second, by the increased friction occasioned by the great pressure on the valves. Third, the carbonization of the lubricating material, whether tallow. oil, or other fat, which was used for the piston and valves. Fourth, the difficulty of preventing the steam from becoming surcharged with caloric, which at times, would be at such an excess, as to melt the joint packings, and heat the steam-pipe red hot.

The first mentioned difficulty is removed by a very novel method, by which the eduction pipe and valve are dispensed with. At the end of the stroke, the metallic piston enters an enlargement at that part of the cylinder, and passes three-quarters of an inch below it, leaving sufficient space for the steam to flash out at the dead point,

into a tube leading to the chimney, at which instant the vacuum valve [?] closes, and shuts off seven-eighths of the steam, which escapes up the chimney, and the other eighth, under the piston, is easily condensed by a spray of water, which is afterward used for generating the steam. At the next puff, the condensed steam, water, and air, are thrown out, and the heated water runs into the cistern of the pump, from whence it is forced into the generator, dispensing with the complicated and expensive air-pump, as well as with condensing water.

The second difficulty is removed by rendering the employment of an eduction valve unnecessary; for the induction valve requires to be only one thousandth part of the area of the cylinder; the power required therefore to lift it, (even if the valve was not so constructed as to neutralize the pressure,) would be very little.

The third difficulty, which was a very serious one, when the temperature of the steam employed was five hundred pounds upon the inch, is removed by using a metallic piston, made of a peculiar alloy, requiring no lubrication whatever, since it glazes by its working. And as for valves, there is only one little, simple, lifting, induction valve, and that, being destitute of friction, requires, of course, no oil.

Fourth, preventing the steam from becoming surcharged with caloric. This important part of Mr. P.'s invention, we, for certain reasons, are restrained from explaining, at present; it is, however, accomplished, and will be made known when the specification of the last patent is enrolled.

We understand, that Mr. P. has taken some orders for his High-pressure, safety-engines, and guarantees the saving of half the fuel commonly used, for a given power, the weight not to exceed one-third of ordinary condensing engines, and not to occupy more than one-third the space: with absolute security from the dangerous effects of explosion.

On the Explosion of Steam Boilers. By Jacob Perkins, Esq.

It has been generally considered a well established fact, that the caloric of steam, at a given elasticity, is invariably the same, when in contact with water; but this is far from being the case. It may be, and often is, so generated as to indicate very high degrees of temperature without a corresponding increase of power; so as evidently to prove, that temperature, alone, cannot be relied on as a measure of the elastic power of steam. Many experimentalists have thus undoubtedly been led into error, especially in reference to high temperatures. If any part of the boiler which contains the steam be suffered to become of a higher temperature than the water contained in it, from want of a sufficient supply, the steam will readily receive an excess of caloric, and become surcharged with it, without acquiring proportional elasticity. In some recent experiments, I have heated steam to a temperature that would have given all the power

that the highest steam is capable of exerting, which would have been 56,000 pounds to the square inch, if it had had its full quantum of water; yet the indicator showed a pressure of less than five atmospheres. Having satisfied myself, by repeated experiments, as to the certainty of this curious fact, the thought struck me, that if heated water were suddenly injected into the superheated steam, the effect would instantly be, the formation of highly elastic steam; the strength of which would depend upon the temperature, and quantity, of the surcharged steam, and of the water injected. To ascertain the truth of this theory, I made the following experiments.

A generator was filled with water, and heated to about 500 degrees, and, consequently, exerted a force of about 50 atmospheres; but the pressure valve being loaded to about 60 atmospheres, it prevented the water from expanding into steam. The receiver, which was destitute of both water and steam, was heated to about 1200 degrees: a small quantity of water was injected into the generator, by the forcing pump, which forced out, from under the pressure valve, into the receiver, a corresponding quantity of heated water, and this instantly flashed into steam; which from its having ignited the hemp cord, that covered the steam-pipe, ten feet from the generator, must have been at a temperature of, at least, 800 degrees, which would be equal to about 800 atmospheres; but, from want of water, to give it its necessary density, the indicator showed a pressure of about five atmospheres. Whether the pressure of the steam, which was rushing through the steam-pipe, was at 5 or 100, or more atmospheres, the steam-pipe kept up at the high temperature before mentioned; which I attributed to the steam being surcharged with caloric. The pump was now made to inject a much larger quantity of heated water, and the indicator showed a pressure of from 50 to 80 atmospheres; the throttle valve being partly opened, it soon expanded, to the former pressure of about 5 atmospheres. The water was then injected again and again, and the indicator was observed to oscillate at each stroke of the pump, from 5, to between 40, and 100, atmospheres, according to the quantity of water injected; clearly showing that at this reduced pressure, there was a great redundancy of heat, with little elastic force. It soon occurred to me, that to this might be traced the true cause of the tremendous explosions, that suddenly take place, in low, as well as in high, pressure boilers.

There are many instances, where, immediately before one of these terrific explosions had taken place, the engine laboured; showing evidently a decrease of power in the engine. To illustrate the theory of sudden explosions, let us suppose the feed pipe, or pump, to be choked; in this case, the water would soon sink below some parts of the boiler, which should be constantly covered by it, thus causing them to become heated to a much higher temperature than the water. The steam now being in contact with the heated metal, readily takes up the heat, and becomes surcharged with it.* Since caloric will

* Practical engineers have frequently witnessed the destruction of the packing of pistons, by their becoming charred, although the steam issuing was in contact with the water, the temperature of which did not exceed 230 degrees.

not *descend* in water, it cannot be taken up by the water which is below it. The steam thus surcharged, will heat the upper surface of the boiler, in some cases, *red-hot*,* and will ignite coals, or any other combustible matter which may be in contact with it. If the water which is kept below the surcharged steam, by the pressure of it, should, by any circumstance, be made to take up the excess of caloric in the steam, as well as that from the upper part of the boiler, which has become heated above the temperature of the water, in consequence of the water having been allowed to get too low, it will instantly become highly elastic steam, and an explosion cannot be prevented by any safety valve hitherto used. To show how the water may be suddenly brought in contact with the over-heated parts of the boiler, as well as with the surcharged steam, it will be necessary to state the following facts.

As long as water is not heated above 212 degrees, it will simply boil, and give off atmospheric steam, without the water having any tendency to rise with it; but, as it becomes more and more elevated in temperature, its disposition to rise with the steam becomes more and more apparent. As the steam presses on the surface of the water, in the same ratio as the water increases in temperature, it only boils without rising, as when at atmospheric pressure; but if the steam should be drawn off faster than it is generated, this artificial pressure would be taken off, and the water would rise with the steam in proportion to the suddenness and rapidity of its escape. The water and steam in this mixed state, thus filling every part of the boiler, the excess of caloric in the surcharged steam, as well as the extra heat from the boiler, will be instantly taken up by the water which rises with the steam, by which means the steam becomes sufficiently dense (or powerful) to produce the fatal effects too often experienced, not only from high, but from low pressure boilers. If, for instance, the water (as has before been noticed) should be suffered to get be-

It is very evident, that this steam was surcharged with heat, and was much above the temperature of the water upon which it was reposing, and in a suitable state to produce explosion, had the water been allowed to rise with the steam, by drawing it off faster than it was generated.

* Mr. Moyle, a practical engineer from Cornwall, gave me the following interesting fact:

On going into his boiler room, he observed a ladder, the foot of which rested on the top of his boiler, to be in flames: he instantly ascertained that the top of the boiler, from some cause which he was then unable to determine, had become *red-hot;* with all possible promptitude he ordered the fire to be quenched, which, probably, saved his premises, and, perhaps, his life. Mr. Moyle found, upon examining the boiler, when cold, that very little water remained in it.

A stronger case still, was that of an explosion at the iron foundry at Pittsburgh, North America. As is the practice in North America, a high pressure engine, of sixty or eighty horse power, was supplied with steam from three separate cylindrical boilers, each being thirty inches diameter, and eighteen feet long. One of these boilers had for some time been observed to be getting red-hot; but, as the other two supplied a sufficiency of steam for the work then doing, it was disregarded, until it exploded. The main body of the boiler separated from one of its ends, at an angle of 45 degrees, and passed off like a rocket through the roof of the building, and landed about 600 feet from it.

low any part of the boiler, which is exposed to the fire, the steam will soon become surcharged with heat. If a boiler, thus circumstanced, should have the weight taken from the safety valve,* or a small rent be effected in the boiler from its giving way by the pressure of the steam, an explosion will be sure to follow. A remedy for this kind of explosion, which appears to be the only serious one, is that of not allowing the water to subside below any part of the boiler which is exposed to the fire. In case the water should settle, it may be known by having a tube, with its upper end trumpet-mouthed, and its lower end fixed in the boiler, entering a few inches below the surface of the water; then, as soon as it subsides sufficiently to allow the steam to blow off, the blast will give warning that no time should be lost in supplying water, or checking the fire.† When highly surcharged steam is rushing from the safety valve, or any other aperture, it may be known by its perfect invisibility, even in the coldest day, nor can it be seen at any distance from the valve or cock; it is, however, condensible; as may be seen by holding any cold substance in its range.

* It was stated in evidence at the coroner's inquest taken at the Humber, in the case of an explosion on board of the Graham steam boat, that just before the explosion took place, twenty pounds were taken off the safety valve. Now; if the steam in this boiler had been properly generated, the relief given to the safety valve, could not have produced explosion; but if the water had got low in the boiler, (as was probably the case,) and the steam surcharged with heat, the ready way to produce explosion, was to allow the steam to escape faster than it was generating, when kept in the lower part of the boiler by the pressure of the confined steam.

Several instances have occurred when there has been sufficient warning, by the rushing of the steam from a rent or fracture, for the bystanders to escape from injury before the explosion took place. There has been, at least, one case, where the boiler was raised from its bed, into the air, by the force of the steam issuing from the rent, (upon the principle of the rocket,) before the water had sufficiently expanded by the removal of the steam, caused by the rent or fracture, to take up the heat of the boiler, and the surcharged steam; when an explosion took place after the boiler had been raised many feet in the atmosphere, and it separated with a very great report, one part rising still higher, while the other was dashed with great force on the ground. It is, I believe, a fact, that more persons have been killed by *low*, than by high, pressure boilers.

It is but about twelve months, since sixteen persons were killed by the bursting of a low pressure boiler, in Flintshire. High pressure boilers have since been substituted. Some of the most dreadful accidents from explosions which have taken place in America, have occurred from low pressure boilers.

† This will apply only to low pressure boilers, on account of the height of the column which would be required to balance the pressure of the steam. The high pressure engines, as used in Cornwall, would require a column, varying from 60 to 120 feet; and the new high pressure safety engine, now coming before the public, would require a column more than four times as high as St. Paul's cross, to balance the steam.

FOR THE FRANKLIN JOURNAL.

Facts, and Observations, on the bursting of the boilers of Steam Engines. By ERSKINE HAZARD, Esq., *Civil Engineer.**

THE frequency of disasters arising from the bursting of boilers, in steam boats, both with high, and low, pressure engines, makes it the imperious duty of all those who have given particular attention to the subject, to make public any ideas which may throw light on the cause of them, as they may thereby aid in preventing their repetition. With this view, I take the liberty of sending you the following explanation, which was given to me by our countryman Perkins. He builds his theory, on the ground that the power of steam does not depend upon *temperature* alone, but principally upon the *quantity* of *water* that is contained in a given bulk of it: in other words, that its power is derived from its *compression*. This corresponds with the experience of the late Col. Alexander Anderson, who gave me the same theory many years since, and at the same time informed me, that when distilling by steam, he uniformly found *the quantity of liquor* produced in a given time, to be in exact proportion to *the pressure within* his still. He hence concluded, that atmospheric steam, confined in any vessel, in such a manner that it could not get an additional supply of water, might be *heated red hot,* without bursting the vessel, or increasing its power. Perkins states, that he has completely realized this idea, in his experiments. He also mentions a fact communicated to him by Mr. Williams, principal manager of the Dublin and Liverpool steam company, which was this. The people on board the boat were alarmed, while on their voyage, by the smell of *pine* smoke, and concluded that the boat must be on fire; but upon searching, they found a piece of pine wood on the top of one of the boilers, which was nearly burnt to a coal; it was in such a situation, that no fire could have communicated with it, except through the top of the boiler. The engine at the time, was working with steam only a few pounds above the atmospheric pressure. Upon mentioning this circumstance to the captain of one of our Delaware steam boats, he informed me, that the leaden joints of his steam pipe were once melted, when the steam guage indicated only the pressure at which they usually worked. In both these cases, the water was so low in the boilers, that the heat was communicated to the steam through a portion of the boiler which had no water in contact with it, and which, of course, became red hot, while the steam could not part with its heat, *downwards*, to the water.

The *repellent power of heat*, is the proximate cause of explosion, according to Perkins's theory. This was one of the principal obsta-

* This communication from Mr. Hazard, was received a month earlier, than that from Mr. Perkins, although too late for insertion in our number for May. The facts and reasoning which it contains, are intended to enforce, and confirm, the theory offered by Mr. Perkins; we, however, do not apprehend that our readers will object to some repetition, on a subject so truly of *vital* importance. [EDITOR.

cles he met with in the progress of his experiments on high steam. In his tubular generators, he found it impossible to keep the water *in contact* with the metal, when a great heat was applied, until he adopted the expedient of the pressure valve, loaded with five atmospheres more than the pressure of the steam. The water was, as it were, *wire-drawn*, or passed through the *centre* of the tubes in a fine thread, being repelled by the heat of the sides, which increased to redness, and finally destroyed the tubes. To show this repellent power of heat, he made a hole of $\frac{1}{4}$ of an inch diameter in one of his generators, and adapted a plug to it, which was removed when that part of the tube became red hot; no steam, or water, escaped from it, notwithstanding the steam-guage indicated a very high pressure: a wire was introduced into the hole, to ascertain that it was free. The generator was then suffered to cool to a black heat, when the steam commenced issuing from the hole with great violence. Another experiment was to heat two cast iron bowls of equal dimensions, the one black, the other red hot, and then to pour equal quantities of water into both: the cooler bowl uniformly evaporated the water first. I have frequently noticed very hot pieces of iron, when thrown into a blacksmith's slack-trough, lie red hot for some time under the water, apparently surrounded by an atmosphere of heat, without throwing any steam to the surface. This will never be the case if the *tongs be plunged* into the water with the hot iron; as their heat, in some part, is only sufficient to raise steam, and not sufficient to prevent the water from coming in contact with them, and through them, with the whole mass, successively. From the above facts, Perkins's explanation of the bursting of boilers, will, I think, appear very plausible: it is this; that the water is suffered to get so low as to bring a portion of the boiler, not covered with water, in contact with the fire: this becomes red hot, and imparts its heat to the steam; the redness gradually extends itself below the water, which is at length repelled from the boiler, and thrown up among the *hot steam*, (like a pot suddenly boiling over,) which surcharged steam, immediately imparting its *excessive* heat to the water, forms steam of the greatest power, and occasions the disastrous explosions.

In the late accident on board the Oliver Ellsworth, it seems to be impracticable to ascertain what was the state of the water in the boiler; but supposing it to have been at the proper height, may not the motion of the vessel, from a head sea, have left portions of the boiler exposed to the fire, for a length of time sufficient to make them red-hot, and the above theory be thus rendered perfectly applicable? Should this be the fact, it appears to me, an additional security would be obtained, by having the boiler divided by partitions, which, though not tight enough to prevent a regular communication from the supply-pump, and steam-pipe, to every part of the boiler, would still be sufficiently so to prevent the water from rushing, in a body, from one extremity to the other, thus leaving portions of the boiler unprotected from the fire. These partitions might be constructed of rough boards, in such a manner that they could be removed when

the boiler required cleaning, and would rather favour, than retard, the process of making steam.

The bursting of the boiler of the Ætna, was attributed to the supply-pipe being choked. To this then, the theory is perfectly applicable. Your obedient servant,

ERSKINE HAZARD.

Philadelphia, April 16th, 1827.

FRANKLIN INSTITUTE.

THIRTEENTH QUARTERLY REPORT.

At a meeting of the Franklin Institute, held at their Hall, on the 19th of April, 1827, the following Report of the Board of Managers was read, and accepted.

PHILADELPHIA, APRIL 19, 1827.

In accordance with the laws of the Institution, the Board of Managers of the Franklin Institute of the State of Pennsylvania now present to the general meeting, their thirteenth Quarterly Report.

Since the period of the last quarterly report, the several courses of lectures, on Mechanics, Chemistry, and the Natural History of the Earth and of Man, have terminated, having been continued regularly throughout the season. Besides the subjects included in these regular lectures, several others have been treated, by members who have volunteered for that purpose. Mr. Jno. Finch, a gentleman distinguished for his knowledge in Geology and Mineralogy, has recently commenced a series of lectures upon those subjects, to which the members of the Institute have free admission.

At the commencement of the lecturing season, the courses were all very well attended, but as they proceeded, much inconvenience was experienced from the indecorous conduct of a considerable number of boys, whose only object in attending must have been amusement, as many of them were wholly disinclined, and others too young, to derive benefit from the lectures. Owing to this circumstance, a large proportion of the senior members declined attending, as the courses advanced. The Board have been extremely desirous of extending to the younger classes of the community, the advantages offered by the lectures delivered in the Institute; but after fairly trying the experiment, they will find themselves compelled to restrict their attendance, within much narrower bounds than heretofore.

The High School of the Institute continues with its full complement of pupils; and its discipline, and course of instruction, are in a state of progressive improvement. An examination of the scholars was held before the committee of Instruction, in the beginning of this month, which was found very satisfactory. It is intended to hold a public, and thorough, examination at the close of the session in July.

Since the last meeting of the Institute, a final settlement has been made with the contractors for the Hall. Some additions to the build-

ing are yet required; such as iron railing in the front and along the sides, which were not included in the contract; these will be completed, as soon as the state of the funds will justify it.

It has been determined to place iron pillars under the girders in the lecture, and court rooms; for although no danger is apprehended of their breaking, they have not been found to possess sufficient stiffness for rooms so large. There was a novelty in the mode of trussing these girders, respecting the efficiency of which there was, in the first instance, considerable contrariety of opinion; they were, however, after much discussion, finally adopted, but it must be confessed that the experiment has not been found a successful one. The necessary alterations will not be attended with any considerable expense or inconvenience.

The Treasurer's report, which is herewith presented, exhibits a balance in hand amounting to $143 75.

By order of the Board of Managers.

Clement C. Biddle, *Chairman.*

Thos. P. Jones, *Secretary.*

Report of the Committee of Inventions, of the Franklin Institute, on the plan of a Floating Dry Dock, invented by Edward Clark, *Civil Engineer.*

The Committee of Inventions of the Franklin Institute who have had under examination the plan of a Floating Dry Dock invented by Edward Clark, civil engineer, of New-York, report—

That this dock is proposed to be constructed by forming a float of timber, which is intended to constitute the bottom of the structure, and which by its buoyancy, is to support a vessel, within the dock, with its keel above the surface of the water; to attain this end, the float is to be made in the form, of a large hollow box, formed of strong logs, firmly joined together, and calked so as to render it water tight; the capacity of the hollow part must be such that when exhausted of water, by means of pumps, it shall be sufficiently buoyant to sustain itself, with its load. The Committee annex to this report a drawing of the proposed dock, with its appurtenances, which, with the accompanying references, will be sufficiently explanatory of the design.

Whilst the Committee award to the inventor much credit for the ingenuity which he has displayed, and are convinced that it is practicable to construct a dock upon this plan, and that the piers, supports, and braces, are well calculated to give all the stability to the structure of which it is susceptible, they are of opinion that great practical difficulties would present themselves in the construction and use of this dock, as well as in others which have been projected with similar views.

The Committee do not deem it necessary to enter into calculations to estimate the dimensions of the float requisite for a large vessel, the size and weight of the materials to be employed, and the capacity of its chamber; the data for these calculations being within

the reach of every one, conversant with the subject of engineering. The main objection to docks of this description, made sufficiently capacious for large vessels, and for the operations to be carried on in repairing them, is the unequal pressure to which their bottoms must be subjected, by the weight of the vessel upon them, and the upward pressure of the water. They are aware that by judicious shoring much of the weight of a vessel may be distributed over the bottom, this however, although it would lessen, would not remove the objection.

Ships, although constructed in a shape, and braced in a manner calculated to render them stable, undergo, in nearly every instance, a change of form, after they are launched; to this change of form, the float in question, would be much more liable, in as much as its flat surfaces are less calculated to resist the effects of the pressure to which they are to be subjected.*

In situations where marine rail-ways can be erected, the Committee believe them to be preferable to a floating dock, howsoever well, the latter may be constructed; there are, however, many places where the soil and other circumstances would render it extremely difficult, if not impossible, to construct a rail-way: in such situations, and when the vessels to be repaired are not of the larger class, the floating dock may be found advantageous; and they believe that under such circumstances, the plan before them presents considerable advantages above those floating docks from which the water must be excluded by flood gates.

PHILADELPHIA, April 4th, 1824.

Attest, THOMAS P. JONES, *Sec'y.*

Description of the Floating Dry Dock, the plan of which has been submitted to the Franklin Institute; with an engraving, and explanatory references. By EDWARD CLARK, Esq.

For sometime before, and even after I entered into engagements with the New York Dry Dock Company, in the spring of 1825, my attention was drawn to the construction of a floating dry dock. The plans proposed by Commodore Barron and Capt. Caldwell, as contained in the Franklin Journal for Jan. 1827, occurred to me, and

* The report of the Committee of Inventions, on my Floating Dock, has been shown to a very respectable ship builder of this city, who concurs in opinion, with the committee of the Franklin Institute, in respect to the difficulties and objections to the practical use of this plan, provided the ordinary mode of building be resorted to in the construction of the float; but he, nevertheless, thinks, that by increasing the depth of the frame, so as to introduce an extra quantity of timber into it, and securing it well with iron, a dock may be constructed at a reasonable expense, capable of sustaining our largest trading ships, without perceptibly yielding to the inequality of pressure which would be produced by any change of form which the superincumbent vessel had undergone; and, consequently, that such vessel would as readily resume its original form on the deck of such a float, as on the common rail-way. And further, if such should not be the case, by resorting to the ordinary mode of wedging, the keel of the vessel may be made to conform to the required line.

New York, April 25th, 1827. EDWARD CLARK.

were severally considered, at least in their general principles, if not in detail; and I went so far as to examine a site belonging to Saml. Leggett, esq. on Long Island, with a view of building one conformably to the latter plan. But on more mature reflection I abandoned them both; that of the Commodore, on the grounds 1st, of the unequal quantity of water, comparatively speaking, that it would be requisite to displace to accommodate vessels of different capacities; for it is evident that the dock must be freed of water, every time a vessel is admitted, in order to allow of its thorough repair, and for convenience to the workmen; and vessels of the same draught, often vary from one fourth, to one half, in the quantity of water they displace, owing to their difference of model. 2d, of the loss of buoyancy occasioned by elevating the hollow sides of the dock above the water line, or their bearing on the water, and consequently the loss of power, applied to create this buoyancy, and also to sustain the materials of which the sides of the dock may be constructed, above water, and 3d, because such docks would be dark and wet, and not sufficiently commodious for the repair of ships, &c. That of Captain Caldwell, was objected to, first, on account of the great expense required for its construction, and secondly, from the remoteness of the site from the city.

As a substitute for these contrivances, I proposed to the directors of the company, the plan of which, the enclosed print presents one view, viz: the stern of a vessel resting on a floating dock. A. representing the float. B. B. piers, forming a recess to steady and secure the float. C. C. perpendicular supports and braces, appended firmly to the piers; and D. D. also supports and braces appended firmly to the float, so as to allow, by means of the rollers e. e. e. e. of the easy and steady ascent and descent of the float, conformably to the motion of the tides and waves, and also of sinking and raising the float in the same place. F. vessel's stern. G. G. bilge blockings. H. H. braces; all for supporting, and steadying, the vessel in an upright position. I. timbers, framed into the piers, forming a bed for the support of the float, while sunk. The float A. is supplied with valves and pumps, not represented in the print; and if it be required to float the vessel F. nothing more is necessary but to open the valves, when the float, being previously ballasted, will fill with water, and sink to its bed. The vessel F. being now removed, and another made to occupy its place, by means of guides, the valves are to be closed, and the pumps put in motion; and when a quantity of water has been displaced from the float equivalent to the weight of the incumbent vessel, she will be elevated entirely above the water, without loss of power, and placed in a most favourable situation to undergo repairs. A float of this description, for use in sea water, would require to be coppered externally, and occasionally to be filled with some other saline fluid, or with fresh water, to preserve it from the worms.

After reflecting on the various plans presented, and consulting eminent engineers, the borad of directors concluded to adopt the marine rail ways of Morton's invention, which have been completed

with some slight, or immaterial variations; but at the extravagant expense of between seventy and eighty thousand dollars. This company are now building others on the same plan; they will not probably cost half as much. But however cheap they may be built, where the rise and fall of the tide is trifling, they will always be found too expensive, excepting in large cities.

The plan I now offer for consideration and report, will, it appears to me, generally, answer a better purpose, than rail-ways, and perhaps, than the docks of Commodore Barron, and Captain Caldwell; but of this I must leave others to judge.

EDWARD CLARK.

New York, Feb. 25th, 1827.

FOR THE FRANKLIN JOURNAL.

Observations on an "Essay on the art of Boring the Earth for the obtainment of a spontaneous supply of water."

NEW YORK, APRIL 30, 1827.

To the Editor.

SIR—I observed in your valuable Journal, some time ago, a favourable notice of one of the most absurd* Essays that I have ever met with, "on the art of boring the earth for the obtainment of a spontaneous flow of water, &c." in which the author maintains the practicability of obtaining water above the surface, in any situation which the borer chooses. I have been looking for a refutation, or exposure, in your late numbers, but perhaps you have been too much engaged to refute it yourself, and your correspondents have thought it useless to combat the absurdity of the new theory, or have been awed by the appalling appeal to facts, which is so confidently made in support of it. It would be a laborious undertaking to review the whole pamphlet of 46 pages, and it would occupy too much of your paper; suffice it to say, there is not a *single fact* stated in it, that militates in the slightest degree from the received, or if you please, the old theory of obtaining water; but wrong *inferences* to that effect, abound. The essay commences with observing that boring "has been known in Europe for the last fifty or sixty years. It was, however, but a partial operation, being no farther practised than to ascertain the presence of coal and other minerals, and to give a greater quantity of water to wells that did not, at all times, afford a sufficient supply." Allow me to make a few extracts from Dr. Darwin's "Phytologia," (my copy of which was printed in 1800) illustrative of the true theory. "Many modern philosophers have attempted to show, that all the continents and islands of the world have been raised out of the primeval ocean by subterraneous fires; hence the strata which composed the sides of mountains, lie slanting downwards, and one, or two, or more of the

* Extract as a specimen of the absurd—"There are, no doubt, large cavities at the bottom of the sea, into which the sea would undoubtedly fall, were it not upheld by the vast columns of gases that are present," page 33.—See also last paragraph of page 34, all 35, and part of page 36.

external strata not reaching to the summit when the mountain was raised up, the second or third stratum, or a more inferior one is there exposed to day. This may be well represented, by forcibly thrusting a very blunt instrument through some folds of paper, a bur will be raised, with the lowermost leaf standing highest in the centre of it." "On this uppermost stratum, which is colder, and is more elevated, the dews are condensed in large quantities" (in addition to the rains) „and, sliding down under the first or second, or third stratum which compose the sides of the hill; and either form a morass below, or a weeping rock, by oozing out in numerous places; or many of these less currents meeting together, burst out in a more copious rill." He also gives an account of "boring a hole near the Derwent in Derby, about fifteen yards deep; the water rose above the surface of the ground, and has continued to flow now for above twelve years, in rather an increasing quantity;" probably as the bored hole wore larger, "it supplies Dr. Darwin's house with two or three hogsheads of water a day; and Mr. Strutt has sunk a well for the use of his steam engine, 200 yards from the former, which supplies 100 hhds. per day." "At Hartford in Connecticut, there is a well which was dug 70 feet before water was found; and then, on boring an auger-hole through a rock, the water rose so fast as to make it difficult to keep it dry by pumps, till the hole could be blown larger by gunpowder; which was no sooner accomplished, than it filled and ran over, and has been a brook for near a century. Travels through America, London, 1789, Lane." And I could give you many more instances where boring for other purposes than to ascertain the presence of coal or other minerals, has occurred, and where water flows above the surface, in conformity with the above lucid explanation; nor do I believe there is an instance where that explanation will not prove the true one. The author of the Essay does not pretend that there is any well in this city* that flows above the surface of the ground; (deep wells or bores that are piped and made tight, and communicate with the water at a great depth below the surface that has filtered through the sand above, will here supply good water by means of a pump twenty or thirty feet long, is admitted) but for support, the new theory, lays great stress upon the evidence of the wells of Brunswick. I shall conclude this communication with an extract of a letter from a friend in New Brunswick, with whom I have conversed upon the subject, and of whose intelligence and correctness, there is no question. "Nos. 1, 2, 3, 4, and 8, are the only ones I am acquainted with; and I must say, that the author has certainly stated truths about them—but has not stated the whole truth. The course of the Raritan River here, for about two miles, is nearly north and south; and the banks for that distance, on one side or the other, are high, and almost perpendicular, and show the different strata as correctly as they could be found by boring, as all the strata in this neighbourhood dip to the north, and crop out at the south. This being the

* It is said the Manhattan Company have determined to have a well like the Widow's Cruise; but I fear if they confine themselves to this island, their bore will have to be as long as their charter—"as long as grass grows and water runs."

case, it signifies but little whether the boring commenced six feet, or sixty feet above the level of the river; and it is only important to know whether the strata bored through are higher where they crop out, than at the place of boring. In the five cases above named, the strata are much higher where they crop out, than the surface of the ground is at the wells." H. B. W.

THE PATENT OFFICE.

We had determined to publish, monthly, a list of the patents obtained in the United States; but have been prevented from doing this, in consequence of not having regularly received the lists from the office. The cause of this will appear from the annexed report, the subject of which, we regret to learn, was not acted upon by the last congress. Every disposition to promote our views, has been evinced by those having charge of the office, and the lists which we have received, have been furnished free of expense. We now recommence the publication, but there is an hiatus from the 14th of September, to the 1st of November, which we hope hereafter to be able to fill.

It is very desirable, that, in the lists, the object of each patent should be more fully expressed, than it now is; this, however, we can neither ask or expect, while there are not clerks to transact the regular business of the office. Measures ought to be taken to urge upon the national legislature, that attention to the patent laws, and to the arrangements of the patent office, which the great interests involved in them, so justly demand. With the hope of promoting this important object, we republish the document before us.

House of Representatives, March 1st.

Mr. Trimble made the following Report:

The select committee to whom was referred so much of the report of the secretary of state, of the 13th of January, 1827, as relates to the patent office, respectfully report:

The patent office was established by an act of April, 1790, "to promote the progress of useful arts." That act was repealed by the act of February 1793, and the office, since that date, has been regulated by the provisions of the latter act. This act secures to inventors the full and exclusive right to their respective inventions and improvements, for the term of fourteen years. It requires each inventor to file a petition, and deliver a written description of his invention or improvement, and of the manner of using it; and in the case of a machine, he is to give a full explanation of the principle, and the mode of application. These descriptions or specifications, together with the models, specimens, drawings, and written references, are to be deposited in the office, and preserved for the use and benefit of the inventor and the public. Each inventor is allowed to take out a patent upon his invention or improvement, upon his petition and specification, and the act declares that the same "shall be recorded in a book to be kept for that purpose in the office of the secretary of

state." The law further requires each inventor to pay thirty dollars into the treasury of the United States, before he presents his petition for a patent, and declares that 'the money thus paid shall be in full for the *sundry services* to be performed in the office of the secretary of state, consequent on such petition, and shall pass to the account of clerk hire in said office.'

The committee have thought proper to refer the house to some of the requisitions of the act of 1793, for the purpose of showing that the government undertakes to perform '*sundry services*' for each patentee when it grants a patent, and requires from each an *equivalent* for those services. Upon inquiry and examination at the office, it is found that the government has failed to perform part of those services; and that the failure has already been injurious; and is likely to become much more so, to the public, as well as to the patentees. None of the patents have been recorded, as the law requires, from the year 1802, to the 4th of March, 1825, and the Committee is satisfied that the failure is owing to the want of the requisite assistance of clerks in the office. The law allows only one clerk to assist the superintendent, and it is believed that two are indispensably necessary to record the patents as they issue, and perform the current business of the office. The present secretary of state directed an extra clerk to be employed in the business of recording patents, and with his assistance, the patents issued after the 4th of March, 1825, have been duly recorded up to the first of May, 1826. No provision was made for additional clerks at the last session of congress; and the extra clerk was dismissed; the consequence of which has been, that the patents issued since the first of May, 1826, are yet to be recorded.

The Committee consider it proper to inform the House that the models are not kept in preservation; and that the utility of the model office is very much diminished, in consequence of its deranged condition, the models being placed on the floor and shelves of the office, in the most irregular manner without any system, order, or classification.

It is the opinion of the committee that the government, after receiving from patentees an equivalent for its services, is bound, in justice to them and the public, to apply the money in performance of its promises: and that the failure on its part to have the patents properly recorded, and the models properly preserved, is in contravention of its statutory stipulations. It is the interest of the public and the patentees, that the records in arrears should be brought up as speedily as possible, and that, in future, the business of recording should be done, if possible, as fast as the patents issue.

The amount of money received into the treasury for fees on letters patent, from 1793 to 1826, is $135,690; and disbursements during the same time was only $63,757. It is certain that there is a balance, of at least, sixty thousand dollars in the treasury, applicable, under the law of 1793, to the account of clerk hire in the patent office, and it is manifest, that the proceeds of the office are nearly double the amount of its disbursements, including salaries, clerk hire, and all other expenses and contingencies whatever.

It is not the policy of the law, nor the intention of congress, to make the patent office a source of revenue; and the committee can see no reason why the money in the treasury, to the account of clerk hire, should not be applied to the service of the office.

It is believed that one or two extra clerks ought to be employed in the business of recording patents, until they bring up the records in arrear, and for that purpose the committee ask leave to report the following resolution:

Resolved, by the Senate and House of Representatives of the United States of America, in Congress, assembled, That the secretary of state be, and he is hereby, directed to employ two extra clerks in the business of recording patents in the patent office, who shall be compensated for their services, out of any balance in the treasury, applicable to the account of clerk hire in said office: *Provided,* that the salary to each shall not exceed the sum of seven hundred dollars.

(The resolution was read three times, PASSED, and sent to the senate for concurrence, and there laid on the table.)

List of patents granted in the United States in 1826.

FOR INVENTIONS AND IMPROVEMENTS.

In the windmill; to Moses Padley, New-York, Aug. 31st.

In hydraulics, called the relieving valve; to Wm. Lanphier, District of Columbia, Sep. 2d.

In the loom; to Samuel Chidester, New-York, Sep. 2d.

In the thrashing machine; to Archibald Douglass, New-York, Sep. 8th.

In the machine for singeing or dressing cloth; to Andrew Robeson, Massachusetts, Sep. 8th.

In the screw boot-tree; to George Nicol, Virginia, Sep. 8th.

In burning stone-ware without salt; to Sandford S. Perry, New-York, Sep. 12th.

In making, iron keyed, bands, with male and female rivetted lugs; to Edward Cooper, Virginia, Sept 14th.

In making glass knobs; H. Whitney and E. Robinson, Cambridge, Mass. Nov. 4.

In the printing press; Samuel Fairlamb, New-York, Nov. 4.

In a machine for cutting fur; Jeremiah Hubburd, James Town, N.C. Nov. 4.

In bilge levers to support ships; John Thomas, New-York, Nov. 6.

In the submarine rail-way; do. do. do.

In the domestic loom; Jeremiah Hubburd, James Town, N. C. Nov. 6.

In the foot gin for cotton; Isaac B. Barnes, Beaufort, S. C. Nov. 6.

In the steam engine; Elisha Bigelow, Baltimore, Nov. 6.

In fastening together the posts and rails of beds; William Bell, Lexington, Ken. Nov. 7.

In the fanning mill; Ovid Pinney and Jas. Olmstead, Caledonia, New York, Nov. 7.

In boring boxes for the hubs of wheels; Ebenezer Johnson, Lexington Heights, New York, Nov. 7.

In a machine for thrashing and winnowing grain; Sylvanus C. Hersey, Rochester, New-York, Nov. 7.

In the construction of furnaces, fire-places, &c. Social Rolph, Wales, New-York, Nov. 8.

In a rotatory steam engine; Elijah H. Reid, Lancaster, Kentucky, Nov. 10.

In the water wheel; Benjamin Raymond, jun. Beverly, Mass. Nov. 13.

In the making and grinding the currying knife; Samuel Brooks, New-York, Nov. 13.

In the machine for cutting cabbage, &c. F. Berkemeger and J. Dangler, Greenwich, Penn. Nov. 14.

In the method of drawing lotteries; William C. Conine, Baltimore, Nov. 14.

In the mode of fastening commode handles; William Price, Pittsburgh, Penn. Nov. 14.

In the steam generator; Daniel Phelps, Bath, New York, Nov. 14.

In the construction of boxes in which to press hay; Ezekiel Waterhouse, Gardiner, Maine, Nov. 14.

In the machine for spinning and reeling cotton yarn; Joseph Woodhull, Chester, New-York, Nov. 14.

In the atmospheric steam engine; William Willis, Charleston, S. C. Nov. 14.

In an instrument for husking corn; Howlet Bushnell, Norwich, Conn. Nov. 14.

In a machine for raising boats, &c. Alfred Warner, Rochester, New York, Nov. 16.

In a mode of dying hair; Joseph Herring, New-York, Nov. 16.

NOTICES.

To correspondents.—We have been compelled to postpone, until the next number, the article on canal boats, by J. Stott, the engravings not being yet finished. The communication from Colonel Long, on the use of anthracite, and bituminous coal, in generating steam, is delayed from the same cause.

Deferred Articles.—Although we have given an extra form, several Editorial articles, intended for the present number, have been crowded out, by the length of those upon the subject of Mr. Perkins's new engine, and upon the cause of explosions in boilers. We apprehend that this will not require an apology.

Geological Society of Pennsylvania.

A society under the above title is about to be organized. The name sufficiently indicates the design of its formation. Many of our most scientific fellow citizens are already enrolled in the list of members.

The essay of T. W. Bakewell, on falling bodies, has just been received, and will appear in our next number.

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END OF VOL. III.

ADDRESS

OF THE

COMMITTEE OF PREMIUMS AND EXHIBITIONS

OF THE

FRANKLIN INSTITUTE OF THE STATE OF PENNSYLVANIA.

AND

A LIST OF THE PREMIUMS

OFFERED TO COMPETITORS AT THE EXHIBITION TO BE HELD IN OCTOBER, 1827.

PHILADELPHIA:

J. HARDING, PRINTER, 36, CARTER'S ALLEY

1827.

ADDRESS.

The fourth Exhibition of the Franklin Institute of the State of Pennsylvania, will be held in Philadelphia, on the 3d of October, 1827, and the three following days.

In announcing the exhibition, and the premiums for 1827, the committee most respectfully recommend them to the attention of their fellow citizens throughout the Union. Experience has proved that the former exhibitions have been of great use; they have introduced producers and consumers to each other. Persons from remote states have learnt at these exhibitions where they can procure the best articles, and on the most favourable terms; and it is now evident that our internal trade is of more importance than our foreign commerce, and although it may be less brilliant, it is more safe; and exhibitions of this kind, it is admitted, are as interesting to the merchant as to the manufacturer.

While the attention of the Institute has been actively employed in measures to improve the manufacturing powers of the country, the managers have not lost sight of its commercial interests; they conceive it to be a necessary result, that the country which possesses the greatest extent and variety of internal productions, will enjoy the greatest, and the most regular, foreign commerce.

The committee respectfully state to their fellow citizens that it is not in the plan of these exhibitions to confine them to such articles only as are new, curious, or singularly fine. All the good and useful products of industry, that admit of being brought, are invited to the exhibition. It must be productive of incalculable benefit to show all the varieties and qualities of articles produced within the country, for supplying its own wants, or to be employed in commerce to supply the wants of foreigners. There is no way in which this can be more effectually done than by each producer sending some of the articles which he makes, to this Congress of American manufactures, skill, and industry. In this assemblage every article will speak for itself.

It is earnestly hoped that the makers of articles which are useful will not withhold them, under the apprehension that because they are common, they will not be interesting.

The attention of the public is invited to the list of premiums which is now offered as honourable rewards for superior articles, or to those who render the country a service by introducing amongst us some new branch of industry, or confer some similar public benefit.

The critical attention of the judges on the former exhibitions, their impartial awards, and the even course the managers have

held towards the competitors from all parts of the Union, was manifested by the distribution of the former premiums, and, we think, must inspire public confidence, and bring forward a numerous list of competitors.

No manager of the Institute can be a competitor for any premium; nor can any premium be awarded to any of its members by any committee of judges. The object of these restrictions is to insure impartiality, and preserve the Institute from the influence of every thing like self-interest.

Competitors for any of the premiums are requested to pay strict regard to the conditions. The regulations have been formed for the purpose of insuring a correct execution of all that the Institute has undertaken. In those cases where the price forms a part of the conditions of the premium, a full compliance with this will be required. To entitle any one to the premium, proof of origin must be given in those cases where this is one of the conditions. No premium will be given on any article that has received one heretofore, or where the quality is not superior to what has been presented at former exhibitions.

Experience has shown that it is impossible for the committee of arrangement to make a proper disposition of the articles if they are not received sometime before the exhibition opens; and it is requested that they be sent at farthest, by the first day of October. All articles that are offered for the premiums, must be at the place that will be designated by the committee of arrangement, on, or before, the above named day.

Exhibiters are requested to have their names affixed to the goods. The committee confidently state it as their opinion, that it will benefit the owners of articles that are for sale, to place the price and the owner's place of residence on them.

On a future occasion the committee of arrangement will advertise the place of deposit, and give to candidates for prizes, and to depositors of goods, such further information as may then be deemed necessary.

(Signed) JAMES RONALDSON,
ADAM RAMAGE,
THOMAS FLETCHER,
A. G. RALSTON,
ABRAHAM MILLER,
SAMUEL J. ROBBINS.

Philadelphia, February 24, 1827.

PREMIUMS.

1827.

Iron Castings.

1. To the maker, in Pennsylvania, of the best specimen of iron castings fit for small machinery, to be cast smooth, and free from sand, fifty pounds to be exhibited—*A Silver Medal.*

Before awarding the premium, the castings must be proved, to the satisfaction of the committee of premiums and exhibitions.

Scale Beam.

2. To the maker of the best and most perfect scale beam for common purposes, superior to any now in use, capable of weighing at least twenty pounds; the beam to be made in the United States—*A Silver Medal.*

Surgical Instruments.

3. To the maker of the best instruments for operations on the eye; the instruments to be made in Pennsylvania—*A Silver Medal.*

Sheet Brass.

4. To the maker of the best specimen of sheet brass; not less than 13 inches in width, or 4 feet in length; fifty pounds to be exhibited—*A Silver Medal.*

Tin Plate.

5. To the manufacturer of the best tin plate, the iron rolled in the United States, and the whole process of tinning performed in any state of the union; not less than one hundred boxes must have been made, and five boxes presented at the exhibition—*A Silver Medal.*

Tobacco Pipes.

6. To the maker in Pennsylvania, of the greatest quantity of tobacco pipes; not less than five hundred boxes. Five boxes must be exhibited, and in case of competition, the quantity will decide to whom the premium shall be awarded; provided they be equal in quality—*A Silver Medal.*

Manufacture of Soda.

7. To the person who shall make, in the United States, the greatest quantity of soda, not less than five tons, fifty pounds of which must be exhibited, and the price at which it can be sold marked on it—*A Silver Medal.*

Silk Cocoons.

8. To the family in Pennsylvania which shall produce the greatest quantity of silk cocoons, not less than twenty pounds—*A Silver Medal.*

Winding Silk.

9. For the best method of winding raw silk, that is in an unusual degree sticky in its gum, or brittle in its texture, without injuring its colour or texture, and at a cost not exceeding that of the ordinary method—*A Silver Medal.*

Sewing Silk.

10. To the maker in Pennsylvania of the greatest quantity of sewing silk, of a good quality; not less than two pounds to be exhibited—*A Silver Medal.*

Straw Plat.

11. To the individual in Pennsylvania who shall make the greatest quantity of straw plat, between the 1st of Jan. and 1st of Oct. 1827; not less than 1500 yards—*A Silver Medal.*

12. To the family in Pennsylvania who shall make the greatest quantity of straw plat, between the 1st of January and the 1st of Oct. 1827; not less than 5000 yards—*A Silver Medal.*

Cooking Grates and Stoves.

13. To the inventor of the best constructed grate or stove for burning anthracite—*A Silver Medal.*

The object of this premium is, chiefly to obtain a grate suitable for domestic purposes, which will unite convenience with economy, and which may be used for cooking. Tastefulness of design, though not a primary object, will be considered, as far as it is compatible with economy. Certificates will be required of the grate having been in use for some time, of the quantity of coal it consumes, and of the effect which it produces.

Steam Engine Furnace.

14. To the inventor of the best constructed furnace for consuming anthracite in generating steam, to be applied to steam-engines—*A Silver Medal.*

Certificates will be required of the furnace having been some time in use, of the quantity of coal consumed, and of the effect produced.

Preventing Explosions in Steam-Engine Boilers.

15. To the person who shall invent and disclose to the Institute, a method of rendering boilers used for steam-engines less liable to accidents from explosion—*A Silver Medal.*

Ample certificates, that the method has been found to answer its intended purpose, to be produced to the Institute.

Smelting Iron ore with Anthracite.

16. To the person who shall have manufactured in Pennsylvania, the greatest quantity of iron from the ore, during the year ending Sep. 1, 1827, using no other fuel but anthracite. The quantity to be not less than twenty tons—*A Gold Medal.*

Use of Anthracite Coal Ashes.

17. For the best treatise on the useful properties of anthracite coal ashes, and the most economical application of them to the arts or to agriculture—*A Silver Medal.*

Coal Grate.

18. For the best constructed grate for burning anthracite, which shall possess the smallest horizontal depth and the largest surface—*A Silver Medal.*

Air Tubes from Coal Grate.

19. For an improved method of introducing heated air into apartments by means of an air tube from a common anthracite coal grate—*A Silver Medal.*

It is essential that it shall not be liable to any derangement which may introduce coal gas into the apartment.

Glass Ware.

20. To the maker of the greatest quantity of glassware, not less than 500 lbs. The fuel used in the manufacture to be not less than three quarters anthracite coal—*A Gold Medal.*

Glass Cutting.

21. For the best specimen of cutting of flint glassware; a variety of articles must be exhibited; and the excellence of their form, as well as the quality of the material, will be considered in awarding this premium—*A Silver Medal.*

Crucibles.

22. To the maker of the best crucibles, suitable for brass founders. The crucibles must be capable of resisting heat as well as the best now in use; one dozen of them must be exhibited, to-

gether with a certificate of their having been made and fully tested in the United States—*A Silver Medal.*

Hog Skins.

23. For the best specimen of hog skins, dressed in Pennsylvania; two dozen skins to be exhibited—*A Silver Medal.*

Harness.

24. For the best set of gig or coach harness, made in Pennsylvania—*A Silver Medal.*

In awarding this premium reference will be made to the excellence of the leather as well as to the workmanship.

Gloves.

25. To the maker of the best buck-skin gloves, the leather to be dressed in the United States, and the gloves to be made in Pennsylvania; not less than five dozen pairs to be exhibited—*A Silver Medal.*

Hydrant.

26. To the maker of a hydrant that shall be adjudged superior in principle to any now in use—*A Silver Medal.*

Vegetable Oil.

27. To the person who shall have made, in Pennsylvania, the greatest quantity of oil, from any vegetable raised in the state—*A Silver Medal.*

The oil must be of a quality suitable to be used as a substitute for Florence or olive oil; the quantity to be obtained not less than twenty gallons.

Madder.

28. To the person who shall cultivate the greatest quantity of madder; the produce of not less than a quarter of an acre.—Samples must be exhibited, with a certificate of the quantity produced—*A Silver Medal.*

Lithography.

29. For the best specimen of lithography, to be executed in the United States—*A Silver Medal.*

The premium will be awarded to the artist who executes the drawing upon stone, of the specimen exhibited.

Infusible Clay.

30. To the person who shall discover, and make known to the Institute, previous to the 15th of August, 1827, an infusible clay, suited to the manufacture of fire bricks or crucibles—*A Silver Medal.*

The bed of clay must be situated in Pennsylvania, New Jersey, or Delaware. It must be of sufficient extent to admit of its being used in the arts, and a barrel must be delivered to the curators of the institute on or before the 15th of August, in order that it may be tried. The object of this premium is to obtain a clay analogous to that of Stourbridge, in England.

Drawing.

31. To the pupil of the drawing school of the Institute, who shall make and exhibit, in October, 1827, the best specimen of drawing—*A Silver Medal.*

All the specimens intended for competition must be prepared in the school, and under such regulations as may be enjoined by the professor of drawing.

Doors.

32. To the maker of the best pair of room doors, manufactured from American oak—*A Silver Medal.*

The doors to be brought to the exhibition, or if in use, submitted elsewhere in Philadelphia, to the inspection of the committee of judges.

Cabinet Ware.

33. For the best piece of cabinet ware, made of oak, or elm, common to Pennsylvania—*A Silver Medal.*

In ascertaining the value of this article, the judges are to take into consideration the elegance, utility, and originality of design, the goodness of the material, and excellence of the workmanship.

34. To the maker of the best cabinet secretary, and book case —*A Silver Medal.*

35. To the maker of the best pier table—*A Silver Medal.*

In awarding premiums No. 33 and 34 the same rules will be observed as in premium No. 33.

36. For the best upright or horizontal piano—*A Silver Medal.*

In awarding this premium, excellence of tone will be considered in connexion with the rules stated in premiums 33, 34 and 35.

Improving Turnpike and other Roads.

37. For the most effectual and cheapest method, verified by actual experiment, of making an even, hard, and durable carriage road—*A Silver Medal.*

It is required, that an accurate account of the method used, and every expense attending it, together with satisfactory certificates of its being effectual, be delivered to the Institute.

Improving the Manufacture of Tallow Candles.

38. To the person who makes known to the Institute, a cheap,

and easy process, whereby tallow candles can be so improved, as to give them a hardness to resist the summer heat of the United States, and render them better suited for an article of export to the West Indies and South America, and, at the same time, not to impair their good qualities by the process of hardening them—*A Silver Medal.*

Woollen Goods.

39. To the manufacturer of the best piece of broadcloth made in the United States; not less than forty yards to be exhibited —*A Silver Medal.*

40. To the manufacturer of the best piece of cassimere made in the United States; not less than forty yards to be exhibited—*A Silver Medal.*

Regard will be had to the quality of the dye, as well as of the cloth, in premiums No. 39 and 40.

41. To the manufacturer of the best piece of sattinet made in the United States; not less than 100 yards to be exhibited—*A Silver Medal.*

42. To the manufacturer of the best flannel made in Pennsylvania, not less than forty yards to be exhibited—*A Silver Medal.*

Assurance must be given, that 500 yards at the stipulated price, will be furnished if required.

43. To the manufacturer of the best green baize made in the United States; not less than 100 yards to be exhibited—*A Silver Medal.*

In awarding premiums No. 42 and 43, price and quality will be compared.

44. To the maker of the best woollen blankets, made in Pennsylvania; two dozen pairs to be exhibited—*A Silver Medal.*

The blankets to be from two to four points: regard will be had to the weight, and no premium awarded unless the quality be equal to that of the imported article.

45. To the maker of the best ingrain carpeting—*A Silver Medal.*

Not less than 100 yards to be exhibited, with a certificate of its having been made in the United States.

46. To the maker in Pennsylvania of the best worsted stockings—*A Silver Medal.*

Not less than five dozen pairs to be exhibited, the price of which will be considered, in awarding the premium.

Cotton Goods.

47. To the manufacturer of the best specimen of furniture chintzes made in the United States; not less than 500 yards to be exhibited—*A Silver Medal.*

48. To the manufacturer of the best specimen of calicoes or prints, for ladies' dresses, made in the United States, not less 500 yards to be exhibited—*A Silver Medal.*

49. To the manufacturer of the best specimen of shirtings, not under No. 50, made in the United States; not less than 500 yards to be exhibited—*A Silver Medal.*

50. To the manufacturer of the best specimen of heavy cotton cloth suitable for labourers' wear, made in the United States, not less than 500 yards to be exhibited—*A Silver Medal.*

The price will be considered in awarding this premium, and the quantity exhibited must be furnished at the stated price if required.

51. To the manufacturer of the best specimen of dimities, made in the United States, not less than 100 yards to be exhibited—*A Silver Medal.*

52. To the manufacturer of the best specimen of jeans, made in the United States, not less than 100 yards to be exhibited—*A Silver Medal.*

53. To the manufacturers of the best specimen of corduroys or velvets, made in the United States; not less than 100 yards to be exhibited—*A Silver Medal.*

54. To the manufacturers in Pennsylvania of the best loom cotton stockings; not less than five dozen pairs to be exhibited —*A Silver Medal.*

Surveyors' Instruments.

55. To the maker in the United States of a theodolite on the most approved principles, equal to the best French or English, in point of character and workmanship—*A Silver Medal.*

56. To the maker in the United States of the most perfect set of surveyor's instruments, comprising a circumferenter, transit instrument, chain and target; to be equal in principles and workmanship to the best imported—*A Silver Medal.*

Porcelain.

57. For the best porcelain made in Pennsylvania, either plain white, or gilt—*A Silver Medal.*

One dozen pieces must be exhibited. It must bear a comparison with that usually imported, in form, texture, surface and price. The latter must of course be stated, and an assurance given that an order to the amount of 500 dollars will be executed at the prices stated.

Blistered Steel.

58. To the manufacturer, in the United States, of the best blistered steel, equal to the English—*A Silver Medal.*

One hundred pounds must be exhibited, the price stated, and assurance given that two tons will, if required, be delivered, equal in quality to the specimen, and at the price stated.

Wrought Iron.

59. To the Iron master who shall exhibit the best specimen of bar iron, not less than one hundred pounds—*A Silver Medal.*

The iron to be tested by competent workmen, and assurance given that ten tons of equal quality, will be delivered, if required, at the price stated.

Files.

60. To the manufacturer of the best files, from American steel. Three dozen to be exhibited, rough, bastard, and smooth cut. The files not to be less than ten inches in length—*A Silver Medal.*

One gross of each kind to be furnished, if required, at the price stated, and equal in quality to those exhibited.

Edge Tools.

61. For the best edge tools, ordinarily used by carpenters or cabinet makers, such as firmers, plane irons, &c. one dozen to be exhibited—*A Silver Medal.*

Fowling Piece.

62. For the best fowling piece, made in Pennsylvania, and equal in workmanship to the best imported—*A Silver Medal.*

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